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Accusing the Innocent. A LARGE fire occured in Boston last week, and the papers announced with all gravity that it was caused by a gas meter. We refuse to believe it. There is a mistake somewhere. It must have been a wire, if a wire can be found within a mile of the place.

The New Board of Political Control. A BILL of which note is made on another page has been introduced in the New York State Legislature providing that there shall be a State Board of Political Control to look after all the electrical companies. We are glad to see that great care has been taken by the framers of the measure to secure thorough political experts as Commissioners on the Board. It is now about time that the New York State Electric Light Association was formed.

Good Station Work. A FEW weeks ago we gave a special article on the new Edison station in Brooklyn, as exemplifying the best engineering practice of the day in central station work. The station has barely been in operation four months, but the first annual report of the local company shows that in that short period it has already established itself on a dividend earning basis. Mr. C. J. Field, the constructing electrical engineer, is entitled to felicitate himself on the results. By the time the station is running up to its full capacity, it will be one of the most permanent and profitable enterprises in Brooklyn.

Closed Circuit Burglar Alarms. IN answer to the recent query of a correspondent, we pointed out the difficulties encountered in the application of a closed circuit burglar system for the protection of ordinary dwellings, in which the frequent attention required by the gravity battery figured as the most important item. An excellent way of avoiding the use of the gravity cell, as pointed out by Professor Jacobus, is to employ the ordinary Leclanché cell in connection with a high resistance relay arrangement, which operates a local. Though current is constantly on the line, it is kept down to such a low quantity that it is incapable of polarizing the Leclanché cell, and hence the latter is able to replace in this instance the closed circuit cell.

Patten's Method of Distribution. THE description which we give on another page of Lieut. Patten's system of distribution cannot fail to impress the reader with the great flexibility of the alternate current, and the rapid strides which it is making toward the accomplishment of all the processes which the continuous current is capable of. It is true, of course, that the alternate current, when applied to a purpose for which the continous current, as such, alone is suited, must be commutated at some point in the circuit; but, on the other hand, the advantages afforded by the constant magnetization of the field in a motor without auxiliary apparatus are made possible by the arrangement adopted.

The Cable Losing Its Grip. WE believe that for a long time to come the cable will continue to serve the public convenience as an efficient means of urban passenger transportation; but we believe, at the same time, that the electric motor is rapidly gaining on it. No other conviction is possible in view of what has just happened at Minneapolis, where the street railway company has actually thrown aside $400,000 worth of cable apparatus before laying a yard of it. It was the settled intention of the company to put down the plant, but the advantages of electricity are so apparent that it has now made new plans, and is proceeding to equip 110 miles of track for electric locomotion. St. Paul follows suit. This incident tells its own story.

The Duty on Copper. THE movement of the National Electric Light Association for the abolition of the copper tariff has reached an interesting stage and entered the sphere of practical politics. We print in this issue the petition presented to Congress last week, and the excellent address made by Mr. George M. Phelps on the occasion, in which he showed that, while the copper tariff is matter of indifference even to a high protection administration, it is a serious hindrance to the electrical industries of the country, all of which, by the way, have grown up under the intelligent form of protection embodied in the patent laws of the country. Mr. Phelps and his coadjutors are rendering an important public service in urging on this repeal.

Electric Railways in Great Britain. THE statistics of electric railways in Great Britain and Ireland, which are given in another column, are chiefly interesting from the variety of systems employed as compared with the number of roads actually in operation or contemplated. But it will be specially remarked that, leaving out of consideration the telpherage system, there is not a single overhead conductor system in operation anywhere. The series conduit method seems to be in favor abroad, and telpherage seems also to be gaining ground. Though the roads in which the rails figure as conductors seem to be a large proportion of the roads actually running, it must not be forgotten that they were the first roads built, and that this practice is only suited to certain favorable situations.

A Four Million Dollar Lesson. WITH the caption we have here used, the *Nationalist* begins an editorial article in which it says that electricity caused the great Thanksgiving fire in Boston, which was due to the license granted the electric companies. Since then "not a word as to any form of control or regulation; the tangle of wires left as before, with dead wires and live ones free to fall in every storm and deal destruction at random." This is amusing in view of the fact that no evidence whatever has yet been adduced to fix the blame of the fire on electricity, and that, owing to the scare arising from the first reports, the city authorities and other bodies have compiled and enforced all manner of rules, regulations and ordinances. The *Nationalist* had better learn to tell the truth before it goes ahead with its great evangel of confiscation for the telephones and telegraphs and other electrical interests.

Designing Transformers. WE bring to a close this week the excellent series of articles on the design of commercial transformers by Mr. J. Swinburne, which have just appeared in *Industries*. Having discussed in the previous articles the design of transformers with closed magnetic circuits, Mr. Swinburne takes up finally the class of transformers of which he has latterly become the champion, viz., the open circuit, and shows in what manner the substitution of the air instead of iron, as a return for the lines of force, alters the design, and its relative effect on the amount of copper and iron required for a given output and efficiency. For those interested in obtaining readings of alternating apparatus, Mr. Swinburne's remarks on instrument transformers will be of value, as showing what errors are to be guarded against. On the subject of that interesting development, the "choking coil," the author seems to lean decidedly to the open magnetic circuit type, but finds it impossible to give an accurate rule for their design.

Incandescent Lamps in Series. ALTHOUGH at one time a large number of series incandescent lamps were employed in this country in connection with arc light circuits, the lapse of time, together with the introduction of the incandescent machines, has seen a large diminution in the number of such lamps; and though the series incandescent system as a system is to some extent still employed in this country, it bears but a trifling proportion to the number of incandescent lamps run on the parallel system. One of the most consistent advocates of the series system, however, from the very beginning, has been Mr. Alexander Bernstein, and that he still clings to his original opinion is well demonstrated in the discussion of the subject which he entered into in the paper read before the Berlin Electro-Technical Society, an abstract of which we give on another page. Mr. Bernstein discerns in the series system not only a saving in the cost of conductors, but what to him seems still more important, a more economical operation of the central station. His method of regulation, it will be noted, involves the operation of the steam engines at speeds corresponding to the load, and indeed his whole system, including the motor generators to be placed in substations, as well as the meters employed in the system, is based upon the direct ratio of the speed to the work done. Mr. Bernstein presents his case forcibly, and we should indeed, for the sake of obtaining actual figures, be glad to see a station erected and operated upon the principles laid down by him. This would afford a good basis for comparison with the parallel system.

Festivities at Dannemora. IT is one of the agreeable features of electrical execution that it resembles the ceremonies consequent upon the death of great chiefs in Africa, in requiring that the decease of the principal shall be attended by various kinds of sacrifices. Every time the electrical apparatus is used, it will, to judge from current events, be tried in a preliminary way, on some poor brute beast. In fact, although no criminal has as yet been gerricided, lots of inoffensive animals have, as far as they were able, attested its efficiency; and the latest sacrifice took place at Dannemora a week ago, when, amid much joking and curiosity, a bull was slaughtered to make a prison holiday. The experiment was hampered by a few difficulties, for, according to the expert special to the daily *World*, "the boiler of the machine supplying the power was defective. It did not give enough revolutions per hour. Once the 'voltmetre' ran up to 2,000 and then sagged back suddenly to less than 1,000." What they wanted, evidently, was a faster revolvable boiler, and a more sedate "voltmetre." But the bull-baiting was successful, and the gallant State matador got in his work at either 400 or 900 volts. The doubt as to the difference of 500 volts is immaterial. "The committee came to the solemn conclusion that 900 volts had killed Taurus McGinty, and that after that it did not matter whether the current sagged back to zero"; from which we infer that zero is 400. Then some of the convicts, looking on, shivered. The day was cold, but it wasn't that kind of a shiver. It was a moral shudder. But the "genial warder" was equal to the occasion, and, desiring that joy should be unconfined, as well among the assisting convicts as the expert picadors and matadors, he brought in the new prison band of 25 members, which then played "Marching Through Georgia" and "Annie Laurie," and "all the other old tunes in great style." It is not stated in the report, but probably "We'll hang George Westinghouse on a crab-apple tree" was played by request. despite the anachronism that, in this merciful age of anti-vivisection societies and preliminary tests of electricity on cats, dogs, horses and bulls, there is no more hanging. Then the festivities ended.

Irish's Automatic Devices for Regulating Electric Motors.

A large number of methods and devices for regulating electric motors have been proposed in the past, and the somewhat extended list is supplemented by several recent devices of Mr. W. E. Irish, of Cleveland, O., with some of whose previous electrical work our readers are already acquainted.

In the first of these methods, illustrated diagrammatically in Fig. 1, Mr. Irish makes use of an expansible strip of metal *A*, which forms part of the circuit. The expansion of this strip, by reason of the current passing through it, magnifies the movement of the arm *D*, the movable end of which is secured to the brush carrier. When the circuit is closed through the motor the strip *A* will expand, and gradually and quickly move the position of the arm *D* and the brushes on the commutator. The adjustment of the strip is such that with a known potential the brushes would be moved to the most advantageous position on the commutator. Let us imagine the brushes as having taken a mean position; it will be readily seen that on any variation of the potential the strip will elongate or contract accordingly, and move the brushes to corresponding sides of this mean position with the desired result.

In Fig. 2, instead of altering the position of the brushes on the commutator, as in Fig. 1, the same kind of expanding strip is caused to vary the strength of the field magnets according to the variation of the potential. In this figure, *A*, which expands in proportion to the amount of current passing through it, supports a plunger in contact with mercury contained in the well. The mercury and plunger are always included in the circuit. Through the side of this well the looped ends of the field coils are passed and arranged, one above another, above the mercury. In the position shown in the figure the circuit is through all the wire on the field magnets; but as *A* expands with a current above the normal, the plunger will descend proportionately, causing the mercury to rise correspondingly in the well and cut out one loop after another, thereby weakening the field until a position of equilibrium is reached. As the potential falls, the strip *A* will contract and lift the plunger, when the mercury will again fall, re-introducing the coils into the circuit and

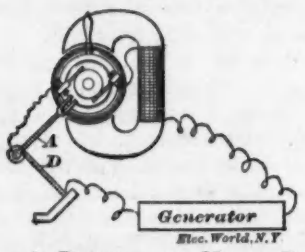


Fig. 1.—Irish's Devices for Motor Regulation.

strengthening the field, thereby maintaining a constant speed.

In Fig. 3 a ball governor driven by the motor is caused, in proportion to its speed, to depress a plunger contained within a well holding mercury. This device is so adjusted that with the proper speed the plunger takes a known position; when the speed increases the plunger will descend into the mercury, causing it to rise and flow along the inclined bottom of the triangle through which the looped ends of the coils of the field magnets protrude. It will be obvious that, as the mercury rises, it will, step by step, short-circuit or cut out coil after coil, thereby weakening the field, and reducing the speed to the normal. According to the fall of the potential, and the fall of the speed of the governing balls, so in proportion will the plunger be lifted in the well, and the mercury flow off the inclined bottom of the trough into the well, out of contact with the ends of the loops, thus introducing their coils into the circuit, and strengthening the field, until the desired speed is again reached.

The arrangement shown in Fig. 4 employs the same kind of governing balls driven by the motor, as in Fig. 3, but instead of cutting out coils or ampère-turns on the field magnets it introduces resistance. At a normal speed the resistance coils are all cut out of circuit by the flooding of their looped ends exposed in the trough to the mercury. On the speed increasing above the normal the plunger will be raised and the mercury will fall down the inclined bottom of the trough into the well, opening the short circuits between the coils, and introducing into the circuit the resistances, step by step, until the normal speed is again attained.

The Mandamus as to High Pressure Currents Denied.

The mandamus asked for by certain persons to compel the Board of Health to remove from the streets electric light wires carrying high pressure currents has been denied by Judge Lawrence. The application was made to him in Supreme Court Chambers, about two weeks ago, and he, on Jan. 15, handed down a decision, in which he says at the outset that the applicants are not entitled to the mandamus because they have "no clear legal right to demand what is asked for" in the writ.

The demand on the Board of Health is that it should make a particular decision on "matters in regard to which the people of the State have vested said board with a discretion which is judicial in its character. Without violating elementary principles as declared by the court of last resort in this State, no mandamus can be granted for such a purpose." Further on he says: "It appears that the Board of Health has acted in the matter and has exercised its discretion and judgment in respect thereto, and with the exercise of that discretion the court cannot interfere."

Judge Lawrence is disposed to think that the act establishing the Board of Electrical Control took away from the Board of Health "all power in respect to electrical con-

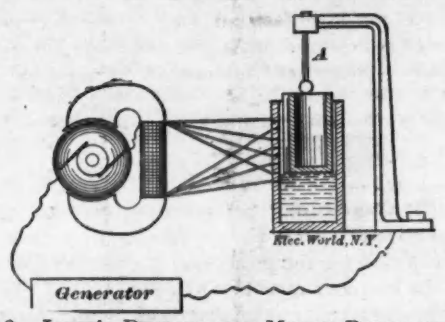


Fig. 2.—Irish's Devices for Motor Regulation.

ductors in the city of New York," and, after quoting the language of the act, he continues: "I am most strongly inclined, therefore, to the opinion that the act of 1887 vests in the Board of Electrical Control exclusive jurisdiction as to the subject matter of this motion."

A New Board of Political Control.

The most important measure thus far introduced at Albany in the Legislature is the bill to establish a Board of Electrical Control, presented on January 16 by Senator Roesch. It wipes the present rotten Subway Board out of existence. Mr. Roesch claims that the bill in its inception and development is his creation, except that it is drawn and built on the broad plan of the perfected railway commission law, which he admits he has closely followed in every detail where it was possible. The board is to consist of three commissioners, one Republican, one Democrat, and one expert who is versed in the science of electricity. The commissioners are to be appointed by the Governor, by and with the consent of the Senate. They are to hold office for five years and receive a salary of $8,000 a year, and additional expenses for traveling. A chief clerk or secretary, to be appointed also by the Governor, shall be the executive officer, and his politics shall be different from those of the expert. This plan is regarded as the best to insure a non-partisan character to the board. The secretary's salary is fixed at $4,000 a year, and the tenure of his office is dependent upon the commissioners.

The principal office of the board shall be at Albany, a branch at New York, and another branch wherever in the judgment of the commissioners is necessary. Monthly meetings shall be held at Albany. The board is endowed with powers similar to those of the Railroad Commission, such as administering oaths, and in having "general supervision of all the telegraph, telephone, electric light, motor, subway conductor or conduit, associations, companies or

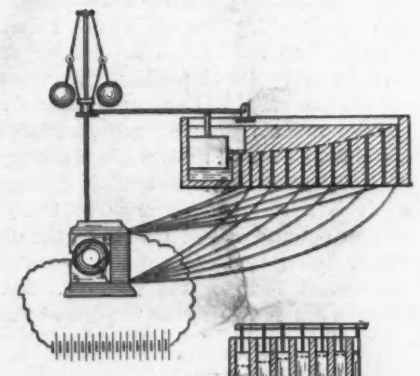


Fig. 3.—Irish's Devices for Motor Regulation.

corporations, and all corporations and associations that in any manner utilize the electric fluid for the public use or for the purpose of commerce." The commissioners "shall examine all companies affected by this act, and keep themselves informed as to their condition and the manner in which they are conducted with rererence to the security of life, protection of property and accommodations to the public. They shall investigate the causes of all accidents resulting in the loss of life and injury to person or persons, or destruction or injury of property which shall require investigation.

The general superintendents or managers of every company coming under the law shall supply all information concerning their company to the board, which is given the power to examine books, compel the production of copies of contracts, agreements, leases, but such information shall not be given publicly under the penalty of conviction for misdemeanor on refusal to comply.

Section 5 of the bill reads:

"No exclusive privilege or franchise shall be granted to any corporation, company, or association, person or persons, by which a monopoly may be created or competition prevented on equal terms."

The commissioners are authorized to change telephone stations or rules, after serving notice on the company interested. They shall report annually to the Legislature, submitting drafts of bills for action before the Legislature. The telephone and electric companies shall be assessed to an amount equal to the yearly expenses of the board.

Neither the commissioners nor any one in their employ shall be interested directly or indirectly in any company that falls under the operation of this act, nor shall they solicit appointments of any company, officer, attorney or agent of any person or persons to any position; they are debarred also from accepting any gift, gratuity or pass, under the penalty of forfeiture of office.

A Sensible View of the New York Situation.

In the course of an editorial on the overhead-wire question in this city, the *Mail and Express* says:

"It is a pertinent inquiry, in considering this matter, why other cities that use the electric light are not afflicted in the same manner as New York, and in what manner the wires are managed in such cities. Brooklyn, for instance, has about as many electric lights and power plants, in proportion to her size, as New York, yet there never has been a man killed in Brooklyn, so far as we can recollect, by a vagrant current or by a shock from an imperfectly insulated wire. In Brooklyn, however, there has been a commission of experts, under whose direction the wires have been managed. Most of the wires were strung overhead, as they were in New York, but proper precautions were taken against bad insulation, and proper regulations were enforced as to the care of wires once strung. Other cities have had a similar experience. Why not take a leaf out of their book?

"It would certainly be possible, under the direction of an electrical commission or a board of electrical control whose members should be entirely competent to their duties, to put into operation a system of overhead wires that would not be dangerous. It has been done in other cities and it

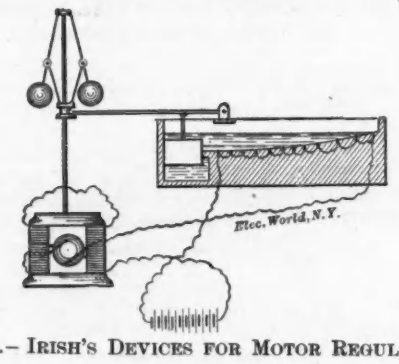


Fig. 4.—Irish's Devices for Motor Regulation.

can be done here. Now, since the present subways are admitted to be inadequate to the task of carrying necessary wires; since the whole present system of subways is acknowledged to be imperfect and merely temporary; since it will certainly take years to provide better subways; since the deprivation of electric light and power is working serious injury to the city itself and thousands of individuals every day, would it not be wise to adopt a temporary system of overhead wires, under expert control and strict regulation, until the present emergency can be tided over?

"It will not do to go ahead blindly, tearing down all the poles and wires in the city, without providing some adequate substitute. The complaints of private citizens and of business houses are already loud and frequent. Every newspaper in the city, it is safe to say, receives dozens of such complaints every day from persons whose health or whose business is suffering from the present state of affairs. The present situation cannot be allowed to continue. Something must be done to alleviate it. Surely, in the apparent absence of any other possible plan, it would be better to adopt a temporary system of overhead wires, under proper regulations, than to go on in the present fashion."

The Electric Wires Proved Innocent.

To the Editors of The Electrical World:

A fire occurred in the work-room of the electric light office here, which is in a brick building, the Real Estate and Law Building. The blame was at once put on the electric wires, as there was a small C. & C. motor in the corner of the room in which the fire started.

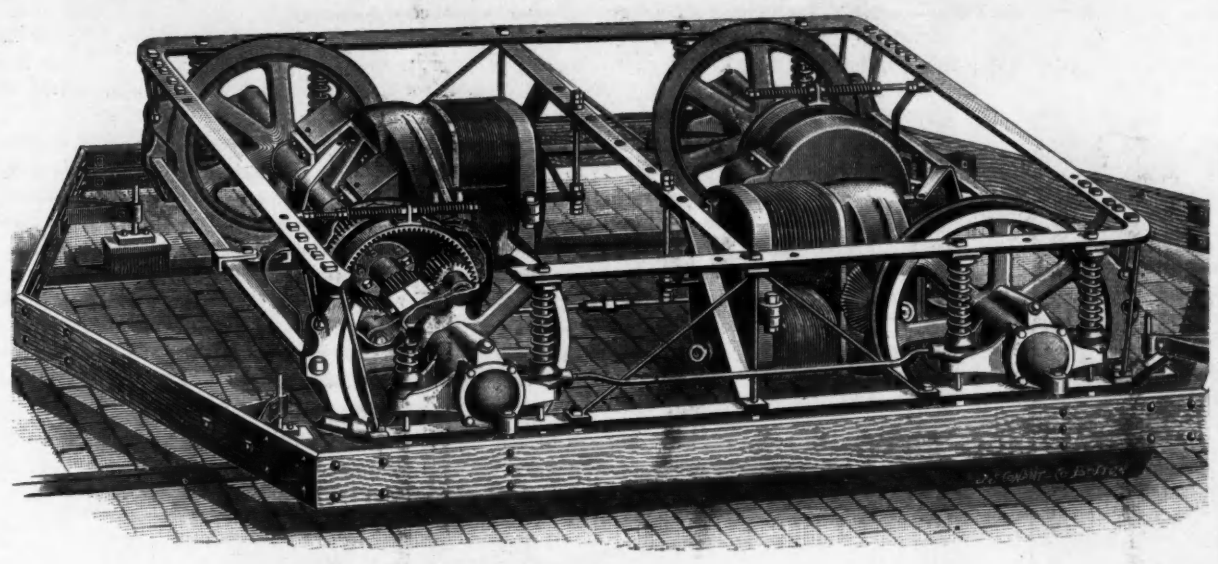
After investigating I discovered that there were no wires within five feet of the place in which the fire evidently originated. It was the fire that burned the electric wires. The motor was connected with the centre fixture by a double conducting cord, the insulation of which was entirely burned away, but not until after the current had been turned off, as the station only runs at night, for the plugs in that room were not blown.

Thinking this might be of interest to you, I concluded to send you an account of it, as it is a case in which the innocence of the "deadly" electric wires has been proved, but they would probably have been made to carry the blame if the building had been burnt to the ground.

Atlantic City, N. J. Harold F. Adams.

Tripp's Electric Car Truck.

As electric railways come more and more into general use, and the economical question is debated as to the comparative cost of electric or animal power on street railways, electrical engineers begin to look for every conceivable device by which electric cars can be made to overcome all possible waste of energy. As one of the most recent attempts in this direction, we illustrate the truck manufactured by the Tripp Manufacturing Company, of Boston. The main feature of the truck lies in the bearings, which consist of Tripp's anti-friction roller bearings, which by actual test are claimed to effect a saving of from 30 to 70 per cent. of the power usually necessary to overcome friction. In these bearings the shaft, instead of rolling in an ordinary journal, revolves on small, hardened rollers, thereby producing a rolling, instead of rubbing friction, and at all times holding the shaft in a steady grasp.



TRIPP'S ELECTRIC CAR TRUCK.

Besides the saving in power thus effected, these bearings give a much steadier motion to the car, especially in putting on and off the brakes. It is often noticed with ordinary journals, the exceedingly unpleasant and jerky motion in releasing the brake, caused by the journal, which bears on the top of the shaft only, being worn by the lateral pressure of the axle when the brake is put on hard. With a bearing which encircles the shaft at all times this, of course, becomes impossible, and a uniformly smooth motion is the result. The truck is very simply constructed, having as few parts as possible. The distance between the top and bottom frame is greater than usual, the two frames being bolted together, and having not only steel spiral springs, but rubber cushions as well. These rubber cushions do not touch each other when the car is in its normal condition. The frame is very light, yet strong, and can readily be taken apart, and by taking off the bottom strap the car can easily be lifted free from the wheels. Owing to the extreme elasticity of the frame-work of the truck, it is specially suitable for electrical purposes, our illustration showing the same fitted with the Union Electric Car Company's gear.

An Improved Form of Closed Circuit Burglar Alarm.

In the January number of the *Stevens Indicator*, Prof. W. S. Jacobus, of the Stevens Institute of Technology, describes an improved form of closed circuit burglar alarm and some of the reasons which led to its construction. Prof. Jacobus started out with the use of the usual open circuit burglar alarm system, but owing to bad wiring experienced constant annoyance, due to the running down of the battery by leaks from dampness. A closed circuit system was then employed, but the trouble experienced with the gravity batteries which required frequent cleaning, caused this system also to be abandoned. It was then determined to put in an improved form of open circuit alarm, the improvement consisting in running each wire in the form of a loop, both ends of which were connected to the annunciator, and arranging a switch by means of which each wire could be tested, to make sure that it was not broken at the time of setting the alarm. The wires ran to the annunciator in separate groups, so that in case either was cut the alarm would still work; in other words, each wire had to be cut in two places, one each side of the door or window that was opened, in order to prevent the action of the alarm. This alarm is still in use in connection with a closed circuit one that will now be described.

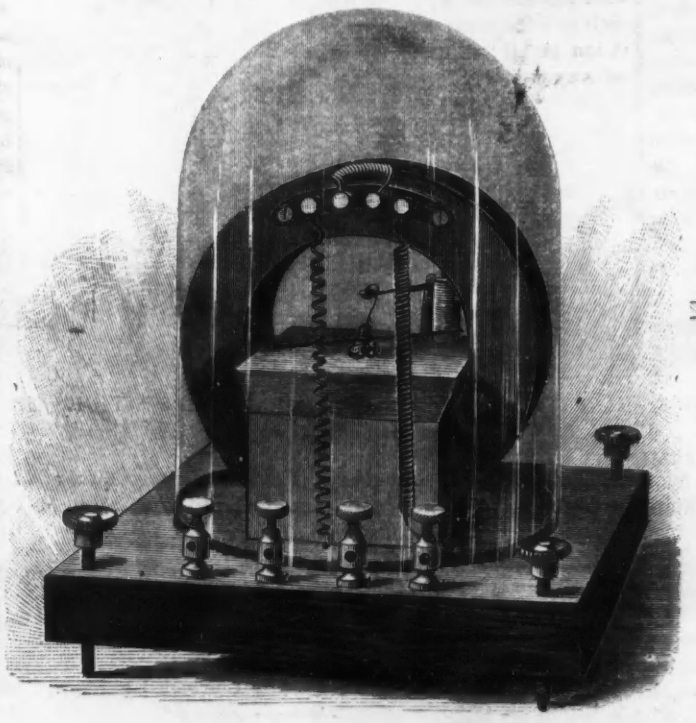
The improved form of closed circuit alarm, which is shown in Fig. 1, is really nothing more than a high resistance galvanometer furnished with a means of making and breaking a supplementary current of electricity that rings a bell. The advantage of this alarm over those of the ordinary relay class is, that a great enough resistance may be employed in the galvanometer coil to allow it to be operated with an extremely small current of electricity, the one in present use being run by a single Leclanché cell which, at its present rate of wear, will last for about four years with a single zinc. All the trouble of maintaining the gravity batteries required to run an ordinary closed circuit alarm is thus obviated, and at the same time we have the advantages arising from the use of the latter.

A novelty in the apparatus is the method of making and breaking the supplementary current that rings the bell; this can be best understood by an examination of Figs. 2 and 3.

Fig. 2 shows a full-sized view of the galvanometer needle *A*, which is supported by the pin *B*, the bearing being made against the agate *C*, which completely insulates *A* from *B*. The pin *B* is fastened into a wooden piece *F*, which has a groove cut in it surrounding the pin, and which groove is filled with mercury *D*. A top view of the mercury *D* is shown in Fig. 3. This mercury comes in contact with the pin *B*, and forms a nearly complete ring about the same, the upper surface of which, on account of the cohesion of the mercury, is raised some distance above the surface of the wooden piece *F*. *E* is a platinum wire fastened to the needle *A*, *H* a cup of mercury and *I* a bent platinum wire fastened to the needle *A* and dipping in the mercury *H*.

The action of the alarm is as follows: The mercury cup *H* is connected to one of the wires of the supplementary circuit, and by means of the platinum wire *I* also forms an electrical connection between this supplementary wire and the needle *A*. The mercury *D* is connected to the other wire of the supplementary circuit. When the alarm is set, a current is flowing through the coil of the galvanometer, and the point *E* falls at *J*, Fig. 3; there is no electrical connection between the needle *A* and the mercury *D*. When the current ceases the needle *A* swings to another position, and the platinum wire *E* enters the mercury *D*, thus completing the supplementary circuit and ringing a bell. In the instrument now in use the bell is arranged with a well-known device that causes it to ring continuously after the alarm has operated, even if the door or window should be shut again and the point *E* come back to *J*.

In the first design the point *E* was made from the end of a fine sewing needle; this, at the suggestion of Professor Mayer, of the Stevens Institute, was changed to platinum, as his experiments have shown that platinum becomes slightly coated with mercury, and is thus affected less by the surface tension of the latter when it is being forced into it.



FIGS. 1, 2 AND 3.—JACOBUS' CLOSED CIRCUIT BURGLAR ALARM.

One of these alarms has been kept constantly running in actual service by arranging it so that instead of breaking the supplementary circuit through the bell, when the alarm is not set, a direct current from the battery is sent through the galvanometer coil. Under these conditions the loss of weight of zinc in the battery was .04 ounce in six weeks. Several readings of the weight were taken during this time, and the loss found to be proportional to the time during which the current flowed.

The galvanometer coil is wound with No. 34 B. & S. copper wire, and has a resistance of 2,590 ohms. The battery is of a modified Leclanché pattern known as the Gonda cell. This class of battery will not require the zinc to be replaced until it has lost about 1¼ ounces; therefore, at the above rate of wear, one zinc will run a continuous current through the coil for 187.5 weeks, or 3.6 years. As the battery will ordinarily be arranged so that it only produces a current when the alarm is set, or say 10 hours each day, instead of 24 as in the above test, it is probable that under these conditions one zinc will last about four years, as previously stated.

Prof. Jacobus considers the best form of burglar-alarm for a dwelling to be one with a closed circuit, of such a high resistance that it may be run with a Leclanché cell, used in combination with an ordinary open circuit alarm. In this case the open-circuit alarm serves to indicate the position of the door or window that is opened, and the closed circuit will give the alarm without indicating the position of the door or window, even if the open circuit fails to work.

Transmission Plant at the Chevrant Paper Mills.

For the last three months the Chevrant Paper Mills at Domène (Isère) have possessed an electric power installation erected by M. Hillairet. The generator and receiver are over three miles apart. The 300 h. p. generator is driven direct by a turbine running at 240 revolutions. The water is conducted to the turbine in an iron pipe half a mile long, the head of water being equal to 230 feet. The receiver at the mills runs at 300 revolutions, and is capable of working up to 200 h. p. The line is run overhead, and consists of a bare copper wire of 50 square millimetres cross-section. The plant works day and night, and is only stopped twice within the 24 hours, for 20 minutes at a time. The average E. M. F. of the generator is 2,850 volts, and the average current is 70 ampères. The electrical efficiency of the installation is 83 per cent.; the commercial efficiency, which has been very carefully determined, varies between 63 per cent. and 66 per cent.

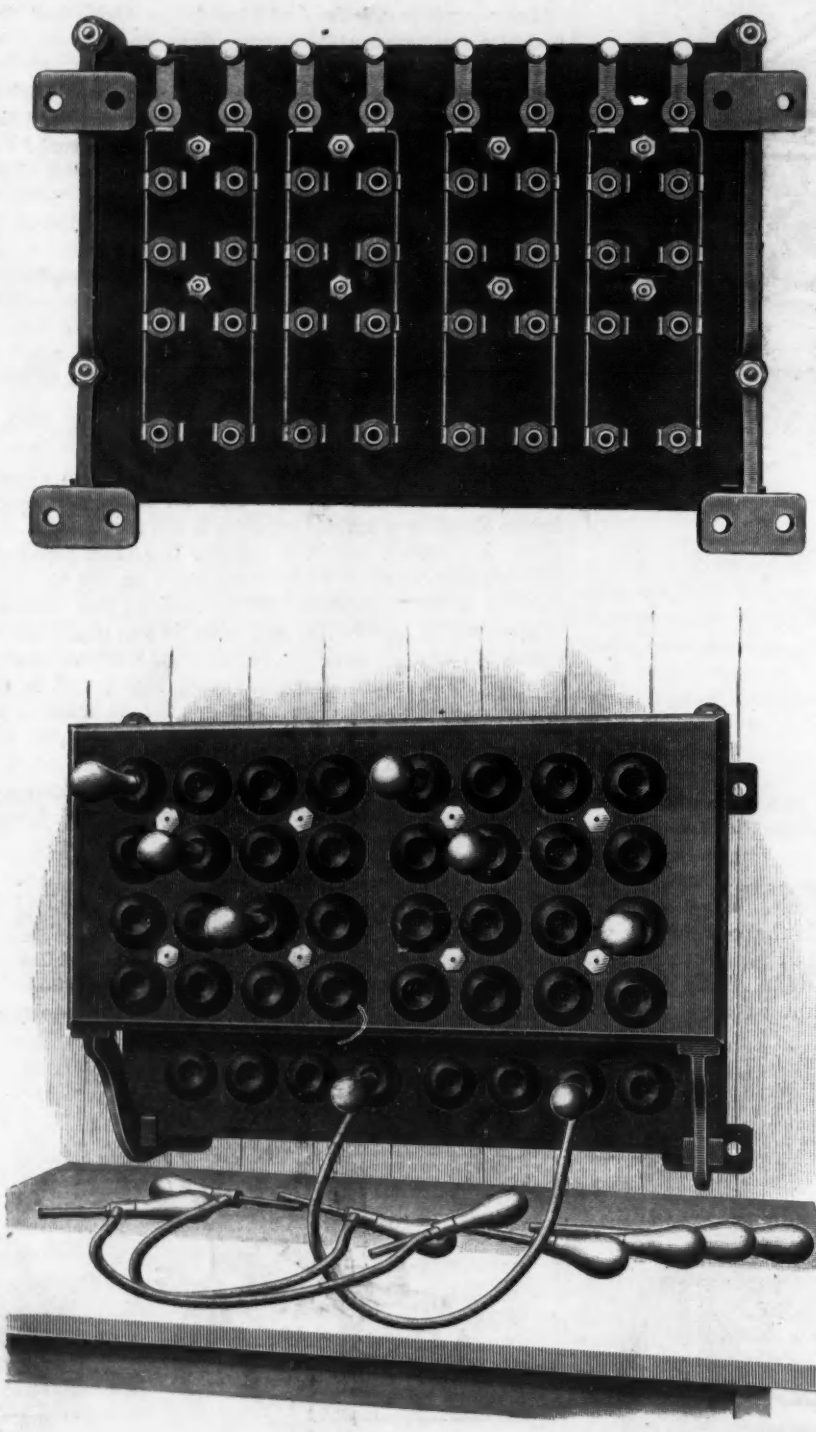
The Paris Telephones.

M. Coulon recently appeared before the Budget Committee of the Chamber of Deputies and made a detailed statement with regard to the working of the telephone system by the State. Referring to Paris, M. Coulon stated that at present 7,000 subscribers were served by 12 exchanges, and the multiplicity of exchanges naturally resulted in considerable delay in making connections. The Paris staff was moreover insufficient and ill-disciplined, and the material handed over to the State by the Société Générale des Téléphones was worn out. M. Coulon asked for the sum of 500,000fr. in order to remedy urgent defects without delay. He proposes ultimately to reorganize and improve the entire system by concentrating all the wires in one central exchange, by extending the telephone to the suburbs, and by erecting a trunk line between London and Paris. The necessary money will be obtained by deducting 1,000,000fr. from the 2,500,000fr. annual profit at presen

made by the State. M. Coulon estimates that in ten years time the gross receipts from the telephone service will amount to 15,000,000 fr., the net profits being at least 7,500,000 fr. M. Coulon also reported that the number of new subscribers to the telephone system, which had fallen to 40 per month at the date of the transfer to the State, was 280 for October, 250 for November, and 180 for the first fortnight of December.

The Thomson-Houston Arc Light Switchboard for Central Stations.

Of all the appliances used in the operation of arc light machines there is nothing of greater importance than a well-designed switchboard. There are but few central lighting stations in which commercial and street lights are not operated, making it necessary, for convenience and economy, to place two or more circuits in series on one



FIGS. 1, 2 AND 3.—NEW THOMSON-HOUSTON CENTRAL STATION ARC LIGHT SWITCHBOARD.

dynamo, to transfer circuits from one machine to another, and to make such combinations of dynamos and circuits as local conditions render necessary. It is most desirable that there should be no extinguishment of the lights while these changes are being made, and that the construction of the board be such as to insure the operator against receiving a shock while so doing. The switchboard shown in the accompanying engravings meets these requirements, being at the same time incombustible, and is of such construction that additions can be readily made without necessitating any changes in the part of the board having the circuits already in position.

The accompanying engraving Fig. 1 shows a front view of the new switchboard, while Figs. 2 and 3 shows respectively a rear and a side view.

As will be seen, the board is made of two rectangular slate slabs, placed about five inches apart, into which are fitted rows of metal bushings, those arranged horizontally on the front board being connected to the dynamos, while the vertical rows on the back are connected to each other and to the circuits. On the back there is one more row of bushings than the front, this extra row being used to connect one circuit with another by means of the transfer cables and plugs.

The switchboard is made for four and six circuits, and is so arranged that additions may be easily made by which the number of dynamos and circuits will be a multiple of four and six. The positive and negative terminals of the dynamos are connected to the left and right side, respectively, of the front board, and the circuits on the rear board in a like manner, the left being positive and the right negative, the bushings for the dynamos being numbered vertically 1, 2, 3, 4; while those for the circuits are numbered horizontally 1, 2, 3, 4.

In order to connect a machine to a circuit, the plugs are pushed through the holes on both positive and negative sides of the board corresponding to the dynamo and circuit desired. To connect any two circuits in series on one dynamo before the machine is started, the plugs are pushed through the holes corresponding to the positive terminal of one machine and one circuit, and then, by means of the transfer cable and plugs at the bottom of the rear board, the negative of this same circuit is connected with the positive of the second circuit which it is desired to place in series with the first; the final connection is made by pushing the plug through the hole corresponding to the negative of the second dynamo and negative of the second circuit.

To transfer circuits from one dynamo to another when the machines are in operation without disturbing the lights, as, for instance, in transferring circuit No. 1 to No. 2 dynamo, No. 1 dynamo is connected to No. 2 circuit by the plug, and No. 2 dynamo to No. 1 circuit. The circuit can then be broken between the dynamos and circuits No. 1 and No. 2, permitting No. 1 dynamo to be shut down, and the positive of circuit of No. 2 connected to the negative of circuit No. 1 by means of the transfer cables and plugs.

The wall space required for a four-circuit board is 19×25 inches, and that for a six-circuit board 24×35 inches.

Another Fast Telegraphy Contest Proposed.

Mr. Fred Catlin, the well-known inventor and telegrapher, of 195 Broadway, sends us the following:

The fraternity should be on deck in 1892 for the World's Fair, ready to ask representatives of all nations to compete with us in the matter of rapid telegraphy, and I think we should have fast-sending contests in 1890 and 1891 to bring out our best talent and prepare us for the grand international event. I propose to undertake, with the co-operation of the telegraph journals, to conduct the tourney for this year, and the success of the affair will depend on the enthusiasm and support of the craft.

I would suggest that the matter used by the senders in the last tournament, with the records of the first four contestants, be published in THE ELECTRICAL WORLD, the *Electric Age* and the *Railway Telegrapher*. It could be used as a guide for operators in gauging their ability, and should they find themselves unable to lead or equal the record of fourth man in that trial it should satisfy them of their inability to compete successfully in the coming one.

I think early in April a good time for holding the tourney.

CLASSIFICATION.

Class A.—Open for all. Entrance fee, $2.

Class B.—Open for all, barring those who are entered in Class A, and J. W. Roloson, W. M. Gibson, and F. J. Kihm, who outclassed all others in the last tournament.

Ladies' Class.—Free for all. The nature and value of prizes, which will be announced later on, will depend upon the *substantial* responses to this call. All who are interested in making the affair a success will have an opportunity to aid it.

If possible the contest should be concluded in one evening, and as there will, probably, be a larger number of entries than ever, perhaps it would be better to limit the number of words to 250. We could then handle about 25 contestants in three hours.

It is generally conceded that the best way to decide upon the merits of the sender is through competent judges as formerly, and the following named well-known gentlemen, and representative telegraph men, have kindly consented to act in that capacity: Walter P. Phillips, General Manager United Press; George E. Holbrook, President Telegraphers Club; E. F. Howell, Official Tester New York Office.

Applications for entrance may be sent to me at any time, the fee to follow before March 18, on which date the entries will close.

I will refer to other details in a future communication, and keep the THE ELECTRICAL WORLD fully advised as matters progress.

The Acoustic Principles Underlying Telephony.

A very large gathering of members and guests assembled at the Electric Club on Thursday, Jan. 16, to listen to a lecture on the above subject which was delivered by Prof. Charles R. Cross, of the Massachusetts Institute of Technology. With the aid of a variety of apparatus consisting of organ pipes, reeds and vibrating strings, Prof. Cross traced out the various properties of sound and showed how these could be divided generally into three distinct classes, depending on their loudness, pitch and quality. These three distinguishing features were illustrated in a variety of ways, and Prof. Cross dwelt specially on the nature of the timbre, in virtue of which we are able to distinguish one instrument from another. He also showed how these sounds of various instruments were produced and were distinguishable on account of the different overtones which accompany the fundamental, and which vary in each instrument. Prof. Cross also alluded to the nature of sympathetic vibrations, and explained the action of resonators. He referred also to the experiments of Koenig, of Paris, who by means of wave discs had been able to imitate the sounds produced by different instruments by superposing the overtones on the

fundamental. Prof. Cross also, by means of a series of tuning forks, brought out very clearly the effects of the co-vibration in the imitation of various instruments.

Coming to the application of these principles to telephony, Prof. Cross drew attention to the fact that a telephone diaphragm, which was set in vibration by a current which was made and broken could only reproduce the pitch of the sound transmitted and possibly, in a small degree, the loudness; but from the very nature of such an apparatus with the intermittent current, all reproduction of the *quality* of the original sound was out of the question. This he demonstrated by placing a vibrating reed in an electric circuit which acted as an interrupter of the current which passed through a primary coil, and which was then reproduced in a telephone placed in the secondary. The original pure tone of the vibrating reed, acting as the interrupter, was, of course, not reproduced in the telephone, which gave out a harsh sound, at the same pitch, it is true, as that of the fork, but lacking in every other quality. At the close of Prof. Cross's lecture, which was delivered in an admirable manner, remarks were made by Prof. George Forbes, Prof. Stevens, Mr. T. D. Lockwood, and Mr. W. D. Sargent and others. The evening was closed by a social reunion of the members, Mr. Henry Hine singing songs and other gentlemen reciting.

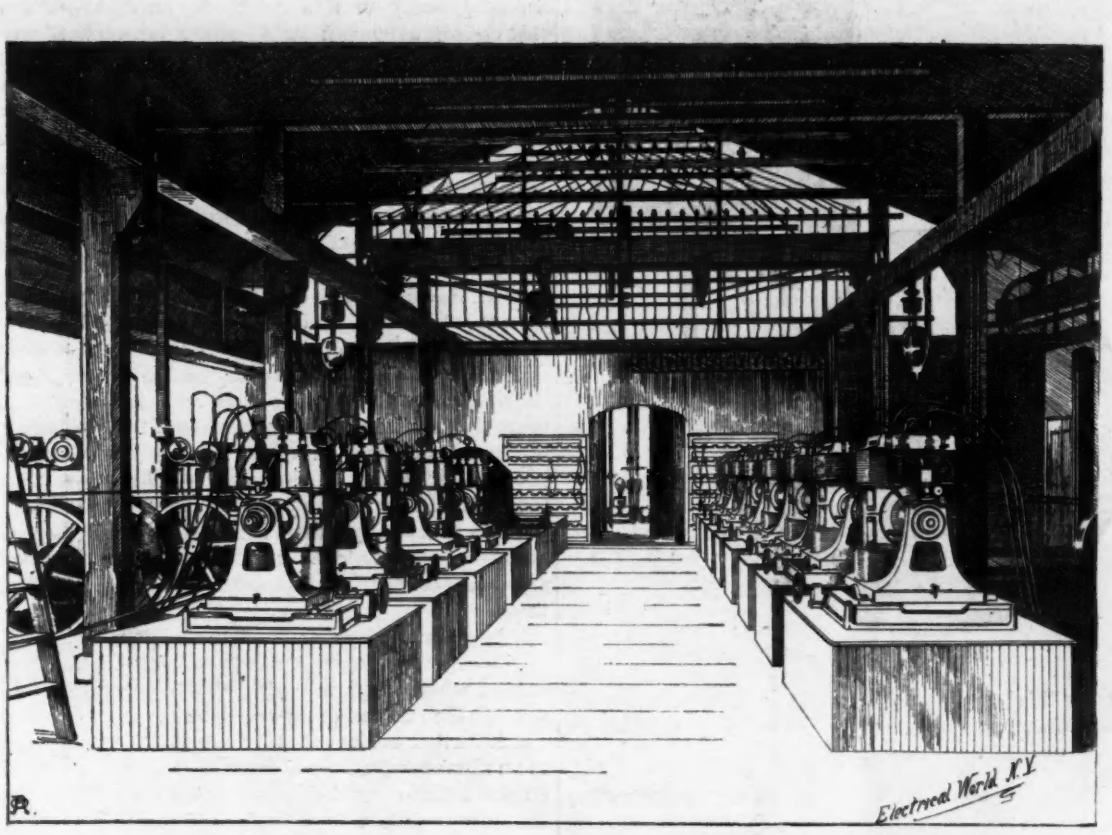


FIG. 1.—THE EAST END ELECTRIC LIGHT STATION, PITTSBURGH.

The New Central Station of the East End Electric Light Company, Pittsburgh, Pa.

The completion of the new arc light plant of the East End Electric Light Company, of Pittsburgh, Pa., may be said to rank this as one of the largest and most important electric light stations in the country.

Commencing with a very small number of lights generated by the direct current system about three years ago, it has kept on growing until the buildings now cover an acre of valuable ground, stocked with machinery generating current for no less than 16,000 incandescent and 480 arc lamps. Its history is interesting, not only to electric light men, but also to those people who contemplate the establishment of an electric light plant.

The company was organized Jan. 20, 1886, with a 300-light Westinghouse direct current dynamo, and a 45 h. p. Westinghouse automatic engine. But the increase was very slow, and the directors of the company decided in June, 1887, to adopt the Westinghouse alternating current system, which had already gained a great popularity throughout the country. A new building for the central station was erected on Broad street, East End, and this structure was equipped with Westinghouse alternating current apparatus for a capacity of 3,900 lights. Two 1,300-light dynamos were placed in the structure as well as two 650-light machines, with two 150 h. p. and two 75 h. p. Westinghouse automatic engines. In addition, the plant held two Westinghouse No. 8 exciters, driven by 25 h. p. Westinghouse automatic standard engines. Four 100 h. p. Riter & Conley boilers represented the steam battery of the plant. The most improved electrical appliances were utilized in fitting up the plant, and when in March, 1888, operations were commenced, it was generally conceded that the East End had a model electric plant.

From the day of its operation, the evidences of success were everywhere recognizable, and the business of the company increased very rapidly. The company made the furnishing of electric lights to private houses a specialty, and in that direction marked success was the result. Applications became so large and so urgent that repeated increases in the plant had to be made. Thus, feeling itself securely placed upon a wholesome basis of a solid business, the company now deemed it advisable to go into the arc light business. A lot adjoining the incandescent plant was purchased and in February, 1889, ground was broken for the building of the arc light plant. This plant was finished a few weeks ago, and the two electric light buildings, viz., the incandescent plant and the arc light plant, are illustrated in the accompanying engravings, Figs. 1 and 2.

On entering the arc light plant from Broad street, one finds himself in a lofty, well-lighted hall of large dimensions. The floor is covered with asphalt and as smooth as a skating rink. Still standing at the door, two rows of electric light machines arrest the observer's attention. There are six Waterhouse arc light dynamos of 35 lights capacity on each side, and at the farther end is the new 60-light machine of the lately invented Westinghouse arc light system. Each machine is placed upon a platform of brown colored wood, a comfortable passage leading between the two rows of dynamos.

Behind the machines runs an underground conduit into which all the wires from the dynamos are conducted. From this conduit they go to the switchboard, and from there to the top of the building into a cupola, from which they are distributed over the overhead mains and lines on the various streets.

A small door from the dynamo department leads into the boiler room. There are two batteries of two Babcock & Wilcox boilers, each representing 240 h. p. The boilers are so piped that each boiler or battery can be used either independently or together. The boilers are supplied by natural gas as fuel at a uniform pressure of twelve ounces. The engines were all furnished by the Westinghouse Machine Company. The arc light plant has been built to admit of machinery for a capacity of 1,000 arc lights.

The incandescent plant is large enough to hold six 3,000-light alternating current machines and two exciters. The apparatus is placed in a position similar to that of the arc light machinery. Everything has been arranged on one floor, enabling the observer to overlook the entire plant from any point in the building. The advantage of this is obvious when it is considered that on this account the company only requires one engineer during the day and one fireman, while at night only two engineers are necessary.

The company is a pioneer in the furnishing of incandescent lamps to private residences, and four hundred houses with 7,000 lights are supplied, and all customers of the company are furnished an alternating current meter. To illustrate the perfection of the working methods of the company, it is only necessary to state that it supplies fourteen churches with the electric current, which is certainly the best evidence of a steady service. The last incandescent lamp is situated five miles from the central station.

The switchboard in the incandescent plant also deserves attention on account of the ease with which it can be operated. Its entire arrangements are placed in a row on one wall, and any one could attend to it after only a short time of instruction.

The officers of the company are: A. T. Rowand, president; J. B. Van Wagener, vice-president; G. P. Shane, secretary and treasurer; J. A. E. Hoeveler, superintendent of construction; A. H. Lucas, chief engineer.

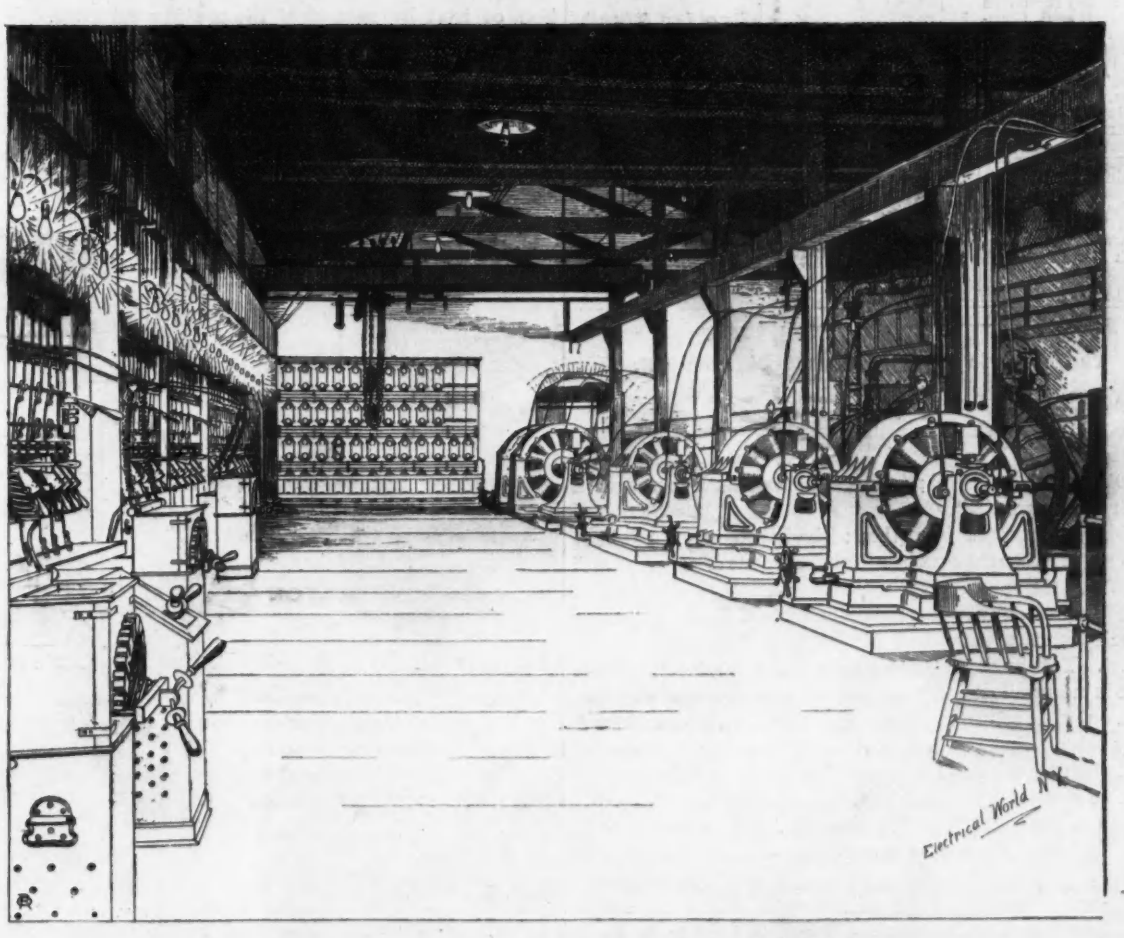


FIG. 2.—THE EAST END ELECTRIC LIGHT STATION, PITTSBURGH.

The Maine Electric Light Association.

The electric central station companies in the State of Maine held a meeting at Portland, and organized a State Association, on Saturday, Jan. 11. This is the sixth of the new bodies of this character.

An inquiry sent to each company in the State asking it if it approved of the proposal to organize a State Association, and if it would co-operate in the movement, had been replied to so generally and favorably that there was reason for expecting about every company in the State to be represented at the meeting. The "overruling providences" prevented such a consummation. The attendance was contracted by "the grippe" and by the breaking up of a hard summer with a change of temperature to 32 degrees below zero on the night of the 10th.

The meeting fully represented the electrical central station interests of the State, however, and was clear-headed and decided in its action. The Association was organized by the adoption of by-laws and the election of the follow-

ing officers: President, Geo. P. Wescott; 1st vice-president, J. W. Wakefield; 2d vice-president, F. M. Laughton; treasurer, W. R. Wood; secretary, F. A. Sawyer; assistant secretary, Geo. E. Raymond. Executive committee—Geo. P. Wescott, Portland; J. W. Wakefield, Bath; F. M. Laughton, Bangor; W. K. Dana, Saccarappa; W. E. Maxey, Gardiner.

A copy of the by-laws and an application-for-membership blank will be sent to every central station company in the State. It is expected that no company will be without a membership.

Electric Railways and Tramways in the United Kingdom.

We give below, from the London *Electrician*, a list of the electric railways and tramways now in operation or contemplated in the United Kingdom. It will be noted that three telpher lines are at work, showing progress in this department.

Place.	Length, miles.	System.	Worked by.
In Operation—			
Alexandra Park....	½	Telpherage	United Electrical Engineering Co.
Barking.....	1¼	Battery.....	Elect. Traction Co.
Bessbrook, Newry ..	3¼	Third Rail (Dr. E. Hopkinson).	Bessbrook & Newry Tramway Co.
Blackpool.....	2	Holroyd-Smith's Conduit.	Blackpool Electric Tramway Co.
Brighton.....	1	Rails as conductors	Magnus Volk.
Carstairs.....	1¼	Anderson-Munro...	Anderson & Munro.
Glynde (minerals)...	1½	Telpherage	United Electrical Engineering Co.
Gravesend.....	....	Series Conduit System.	Series Electric Traction Co.
Portrush, Giant's Causeway.	8	Siemens' Third Rail	Giant's Causeway Electric Tram. Co.
Ryde.....	¾	Siemens' Third Rail	Ryde Pier Co.
In Progress—			
City of London and Southwark Subway	3½	Dr. E. Hopkinson (Mather & Platt).	City of Lon. & Southwark Subway Co.
Eastpool (minerals)..	1½	Telpherage.....	United Electrical Engineering Co.
Projected—			
Bray Electric Co .	1		
Camden Town and Elephant & Castle.	....		
Central London Railway (City and Bayswater).	4¾		
Chesham, Boxmoor and Hemel Hempstead Tramroads.	8	Not yet selected....	Chesham, Boxmoor & Hemel Hempstead Tramro'ds Co
Kensington and Paddington.	....		
Lanark & Hamilton.	15		
Liverpool Overhead Railway.	....		
Lancaster and Morecambe.	..		
Lynton.....	...		
North Metropolitan Tramways.	....	.....	North Metropolitan Tramways Co.
Northwestern and Midland District Auxiliary Railw'ys	7	Series System	Jointly.
Stockwell and Clapham.	1	....	City of Lon. & Southwark Subway Co.
Tottenham-court-road and Shepherd's Bush Common.	....		
Wellingborough and District Tramroads	2½	Series System	Wellingborough and Dist. Tramways Co.
Experimental—			
Birmingham.....	....	Julien Accumulator Cars.	Elec. Construction Corporation.
Clapham, Belham and Tooting (Lon. Tramways Co.).	....	Jarman (Accumulator Car).	Electric Tramcar Syndicate.
South London.....	....	Jarman (Accumulator Car).	Electric Tramcar Syndicate.

The Electric Candle Cure for Rheumatism.

A subscriber at Bryan, O., sends us the following dialogue that he overheard in the street:

"Howdy do, howdy do?"

"Oh, fair to middlin'; folks all well, but I have got a touch of rheumatiz."

"Oh, you can get rid of that: I had it so bad I couldn't raise my hand to take a chaw terbaccer, but it's gone now."

"What did you take for it?"

"Waal, when they put up them 'lectric lights, I got one of their candles they had dropped, and carry it in my pocket. You know 'lectricity is good for medicine. Waal, there is 'nough 'lectricity left in the candle when they put them out that some will soak inter you, and that knocks it every time. Jest try it."

"I will; where can I get one?"

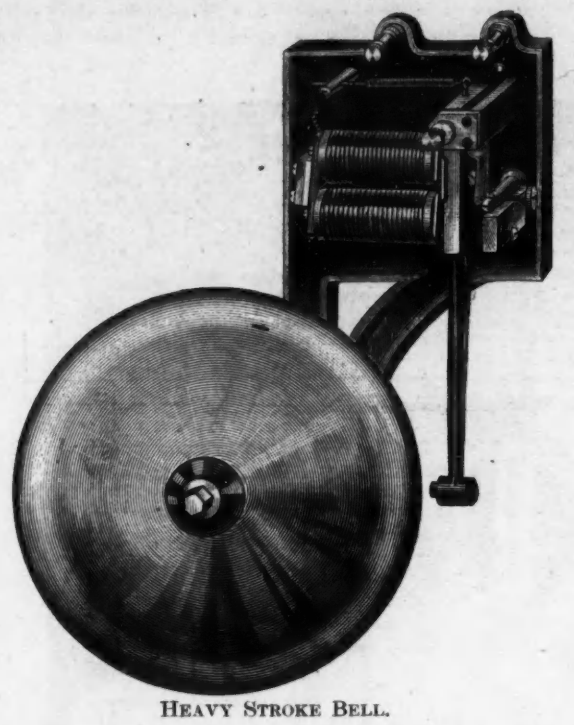
"I've got a couple; take one."

"Much obliged; I'll give it a chance."

The Heavy Stroke Electric Bell.

This new bell was patented April 9, 1889, by Shaw & Geary, Philadelphia, who claim the original feature of a double armature, consisting of a light armature hinged in the face of a heavier one. The lighter section being in the field of attraction of the magnet, and being more sensitive than the heavier one, is drawn to a point very near to the magnet poles, where the attraction is sufficiently great to cause the lighter section to draw the heavier one in the field, and into contact with the poles with great force, allowing the movement of the heavier section to a very much greater extent than with the ordinary solid armature. As soon as the smaller section reaches the point where the attraction is very great, the result will be the drawing of the heavier section swiftly and powerfully to the magnet poles, the lighter section performing the initial movement which takes the place of the sluggish movement of the ordinary armature when placed at a great distance from the magnet, the effect being a very powerful draft of armature into the field of attraction at the beginning of the stroke and an increase in power and velocity until the completion of the stroke.

It is claimed that very little battery current is required



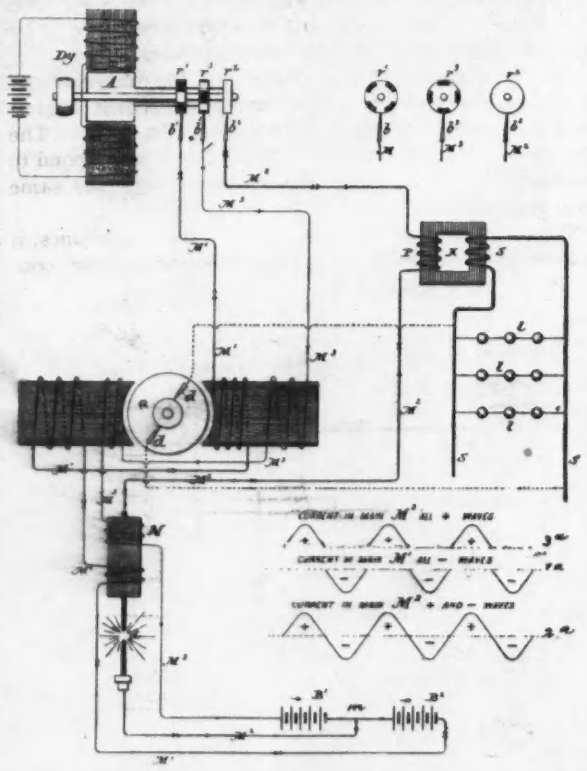
Heavy Stroke Bell.

to operate this bell satisfactorily, and it is specially adapted for fire-alarms, railroads, steamships, etc.

The Patten System of Distribution by Alternating Currents.

In a recent issue we described, in brief, a novel system of electric distribution invented by Lieut. F. J. Patten, and we are now enabled to present to our readers a more detailed account of the same.

The essential feature of Lieut. Patten's system of distribution by alternating currents consists in a subdivision of the current into its positive and negative components, conveying the opposite waves on separate mains and the complete alternating current on a common return for both. The system presents advantages of a novel character, among which may be mentioned the constant magnetization of iron by means of alternating currents and the charging of storage batteries with these currents, by which means direct current devices, requiring a low-tension



Figs. 1 and 2.—Patten's Method of Electrical Distribution.

current, can be operated by a high-tension alternating-current source of supply.

The manner in which this is accomplished will be understood from the accompanying diagram. As will be seen, a dynamo-generator *Dy*, Fig. 1, has its armature *A* connected by one terminal to the continuous ring *r* and the other terminal to the broken rings *r'* and *r* , provided with insulating spaces equal in number to the field poles of the machine; and these rings are so placed on the spindle, with reference to fixed brushes bearing on them, that the insulating segments in one correspond accurately in position to the conducting segments of the other. Three main leads *M'*, M^2, and M^3 are connected to the armature circuit *A* through the brushes *b'*, b^2, and b^3, bearing on the rings, and from these connections it results that the main M^2 will receive a true alternating curent, as represented by the alternating waves at 2 in Fig. 2; and one of the other circuits, as M^3, will receive all the plus or positive waves, and the other *M'* all the negative or minus waves. Thus the diagram 1^a, Fig. 2, pictures the current in circuit *M'*, and the diagram 3^a pictures the currents flowing in circuit M^3. As a true alternating current circulates in the circuit M^2, devices requiring such a current, as the primary of a transformer, may be connected in this circuit, as shown at *K*, and a low-tension alternating current may be taken from its secondary; and devices may be connected in this circuit that require a low tension alternating current, as the lamps at 1 1, or the motor armature *a*. Other devices requiring a high-tension alternating current, as the arc light at *L*, may be connected in the main M^3. The currents in the circuits *M'* and M^3 are intermittent currents of a single direction, one having all positive impulses and the other all the negative impulses of the complete wave shown at 2^a, Fig. 2. From this it follows that the effects of a direct current may be obtained by suitably combining the circuits *M'* and M^3. Thus the two circuits *M'* and M^3 may be wrapped together as independent coils around each of the field cores *N* and *S* of the motor, and if one is wound in a reverse sense to the other the intermittent currents in both circuits will maintain a field of single or unchanged polarity between the pole pieces *N* and *S*. We can, therefore, maintain by these divided currents a constant or unchanged field, and with an alternating current in the armature a constant armature polarity can be maintained by a system of armature connections previously described in this journal.*

By similar arrangement of the circuits *M'* and M^3 the regulating mechanism *N* of the arc light *L* may be controlled, while the high-tension alternating current is taken through the carbons of the arc light *L*.

It is further evident that by means of such connections to an alternating current source of supply, a system of low-tension direct-current distribution over distant local areas becomes possible with a high-tension alternating-current source of supply, and the storage battery may thus be made to convert a high-tension alternating current into a low-tension direct current where required, and this without commutation of the alternating current.

The method of producing this transformation is shown at the bottom of the figure, where the main M^2 conveying the true alternating current is taken to the middle point of the divided storage battery B^1 B^2 and the other mains *M'* and M^3 are taken to the poles of the battery.

It will be seen from an examination of the circuits that both these outside wires *M'* and M^3 cannot be simultaneously closed through the common return M^2, from which it results that a plus wave is sent through one half of the battery from the lead *M'*, and then its circuit to the station through M^3 is opened, and that of M^3 being instantly closed sends the opposite impulse through the other half of the battery, each half receiving a charging impulse in turn. In this manner the batteries are kept stored by the alternating current from a distant source of supply. These supplies of stored energy may be used to operate any direct current devices that may be required.

Many other applications of the divided alternating current by means of a three-wire system of distribution will suggest themselves, the above being only a general outline of Lieutenant Patten's system.

Automatic Carriage Light.

The novelty of an automatic electric light box is now introduced in the carriages of the London District Railway. even in those of the third class. A passenger places a penny in the slot, presses a button, and immediately a bright, soft light gleams upon his newspaper, but for him only, as it issues from the bottom of the box in which the apparatus is confined, and does not irradiate the pages of his neighbor's paper. He gets the whole, as nearly as possible, of his penny worth. His coin sets in motion a clockwork meter, which gives him the light for a quarter of an hour. If his journey is longer, and he desires more light, the investment must be renewed.

Candle Power of Arc Lamps.

According to the *Centralblatt fuer Electrotechnik*, the formula proposed by M. Gérard to determine the spherical luminous intensity of an arc light—namely, ½ horizontal intensity + ¼ maximum intensity—is of sufficient exactitude in practice for arc lamps fed by continuous currents. Experiments undertaken to verify this formula gave the following results, expressed in candle power:

Lamps.	I. horiz.	I. maxim.	Mean calculated.	Spherical observed.
No. 1.....	250	1,464	491	470
2.....	456	3,250	1,040	1,145
3.....	560	3,071	1,048	1,221
4.....	744	1,227	679	692
5.....	122	840	271	274
6.....	586	2,100	818	802
7.....	935	1,150	755	767

The average error is only five per cent., taking the whole of the lamps. The angle of the maximum intensity was about 45 degrees usually, but in some cases it approached that of 20 degrees, or of 60 degrees from the horizontal.

*See The Electrical World, Sept. 28, 1889.

Constant E. M. F. with Variable Speed.

BY PAUL HOHO.

In studying the problem of obtaining constant E. M. F. in dynamos driven at variable speeds, the writer has devised a number of arrangements by which this can be effected electrically without the intervention of wasteful resistances.

Suppose we wish to obtain a dynamo machine having a constant E. M. F. equal to 100 volts, and with a speed varying from 750 to 1,250 revolutions per minute; then Fig. 1 represents the characteristics for a machine for speeds comprised between 750 and 1,250 revolutions. We take from the characteristics the values of the ampère-turns necessary for these different speeds, in order to produce 100 volts, and, plotting these values as ordinates, we obtain in the curve *a b g*, Fig. 2, a reduction of the ampère-turns necessary to obtain 100 volts at the speeds of between 750 and 1,250 revolutions. It will suffice then to provide for the dynamo an excitation variable with the speed, ac-

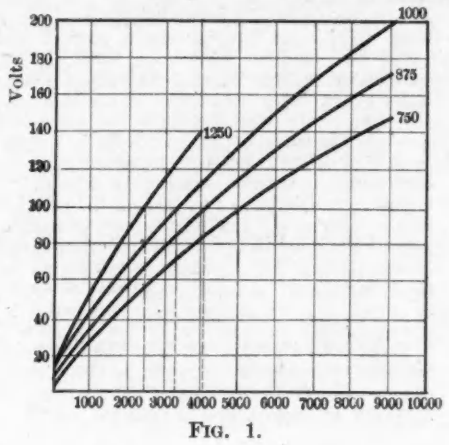


FIG. 1.

cording to the law determined by the curve *a b g*, Fig. 2. The writer's system permits of obtaining this excitation in different ways; among others, by means of two small auxiliary machines, which case we will now examine.

In order to more clearly understand the system we will suppose that the behavior of these two machines is known in advance and represented respectively by the curve *I*, and by the curve *II* of Fig. 3. These curves then give the number of volts produced respectively by the auxiliary machine revolving individually as a function of the speeds. By means of these two auxiliary machines we can excite the magnets of the machine in several ways, among which is the following: A primary exciting circuit is wound on the magnets of the main machine and fed by the auxiliary machine *I*. The second exciting circuit is fed by a current resulting from the difference of the E. M. F.'s produced by the two auxiliary machines; *i. e.*, that this, the second, circuit is put in series with the armatures of the two auxiliary machines the two like poles of which correspond. As shown in Fig. 3, the two auxiliary machines have at 1,000 revolutions a difference of E. M. F. equal to zero. Thus at 1,000 revolutions the second circuit is fed by a current equal to zero, and

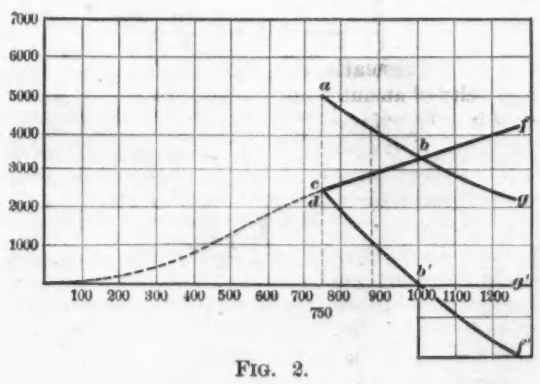


FIG. 2.

the total excitation at 1,000 revolutions ought to be furnished by machine *I* only, in the primary exciting circuit. That is, the first circuit ought to be calculated in such a manner that the E. M. F., *q m*, produced by machine *I* at 1,000 revolutions causes an excitation represented by *b b'*, Fig. 2. It is these factors which determine the constant of the primary exciting circuit. For the other speeds the excitation produced by the first circuit will be proportional to the E. M. F. which supplies that circuit, that is, to the E. M. F.'s represented by the curve *I*, Fig. 3.

It suffices then to furnish an excitation represented by the algebraic difference of the ordinates of the curves *a*, *b*, *g* and *c*, *b*, *f*, Fig. 2, which differences are represented by the ordinates, at first positive, then negative, of the curves *d*, *b*, *f'*, Fig. 2. As has been said, these excitations ought to be furnished in the second circuit by the differences of the E. M. F. of the two auxiliary machines. At 750 revolutions there is a difference of E. M. F. equal to *p' p''*, Fig. 3. The latter ought to produce an excitation equal to *d d'*, Fig. 2, which allows of the calculation of the constants of the second exciting circuit. Thus the excitation required is obtained for 1,000 or 750 revolutions. This required excitation could also be obtained forany two speeds, whatever be the characters of the machines *I* and *II*, and provided that their characters are different.

There remain still the other speeds; for these the excitations to be produced in the second circuit are given by the ordinates of the curve *d b' f'*, Fig. 2. If *p' p''* in Fig. 3, gives an excitation equal to *d d'*, Fig. 2, the curve *p''' m n'''*, Fig. 3, in which *p''' p* equals *p' p''*, and the ordi-

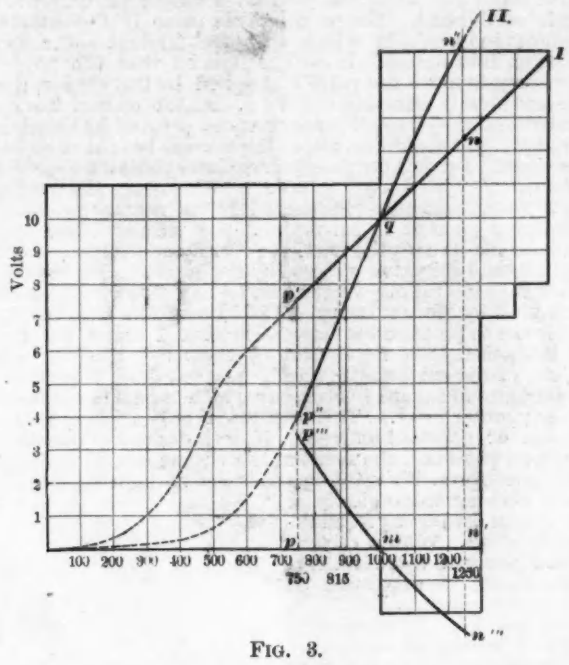


FIG. 3.

nates of which are proportional to the ordinates of *d b' f'*, Fig. 2, represents the E. M. F.'s which ought to be supplied to the second exciting circuit in order to obtain the proper excitation for all the speeds comprised between 750 and 1,250 revolutions. If from the ordinates of the curve *I*, Fig. 3, we subtract algebraically the ordinates of the curve *p''' m n'''* we obtain the curve *p'' q n''*, which represents the character which the auxiliary machine *II* ought to possess, in order that, upon the combination which we have explained. we may obtain a proper excitation for all speeds comprised between the limits given. In this example the curve *p'' m n''* corresponds exactly to that of the machine *II*, because that machine as well as machine *I*, taken in advance, were chosen alike. The more the real curve of machine *II* represents exactly what we have just indicated, the more perfect will be the regularity between 750 and 1,250 revolutions. It is necessary to remark that the regulating influence will already be effected before 750 revolutions are reached, and will continue even after 1,250 revolutions are passed, and that to a degree which will depend on the nature of the auxiliary machines.

The characteristics from which we have started out in the present example affect the form which Professor Kohlrausch determined for a dynamo in 1887. The two curves of the E. M. F.'s. *I*, *II*, in Fig. 3, correspond to the machine, the characteristics of which take the same form as that shown in Fig. 1.

Now, in order to govern the two auxiliary machines, it is necessary to observe, in addition, the nature and con-

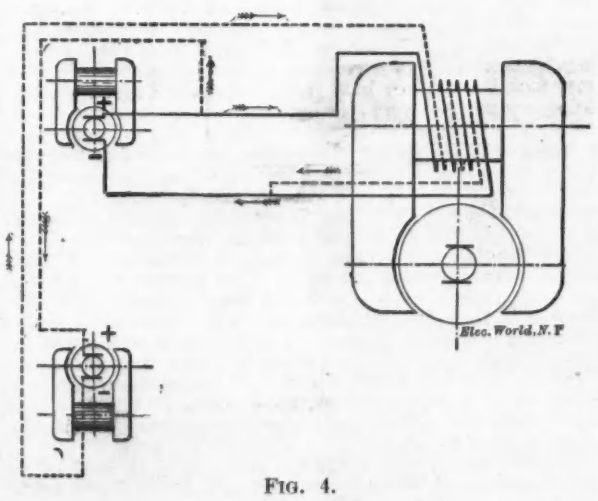


FIG. 4.

struction of the individual machines and the arrangement of new elements. Thus, these two machines may each be excited by themselves and by the other, or by both. The latter, however, would complicate the problem uselessly. In the example which we have described, we arrive at the same results in operating separately the two auxiliary machines on two distinct circuits arranged in such a way as to produce an inverse excitation; that is, a differential arrangement, as shown in Fig. 4.

In the example which we have described we have had recourse to two auxiliary machines for the excitation. If, in order to produce excitation, we employ the E. M. F. produced by the main machine, it is only necessary to take a single auxiliary machine. In that case the calculations are analogous to those already given. It is only necessary to take account in the combination and in the calculations of the fact that this source of excitation is itself subject to the regulating effect. This arrangement is shown in Fig. 5.

It is possible, however, to arrive at the same result without having recourse to auxiliary machines. In that case the exciting currents are taken from different points of the commutator. It suffices that brushes in contact with the latter span those portions of the armature in which the magnetic field varies differently when the speed varies. To that end we are naturally led to subject the armature to the action of different magnets and pole pieces. Among these combinations which may be varied infinitely, we will only mention the following: Let us imagine a machine, the armature of which receives its magnetism from two pole pieces, each of which forms a consequent pole. If that pole piece, instead of being constructed as one piece, be composed of two separate pieces, Fig. 6, so arranged that one is more saturated than the other, magnetically, the magnetic intensity which they will effect respectively in the corresponding portion of the armature will vary in these proportions by reason of the two different functions of the speed. It suffices, therefore, merely to take two exciting currents by means of three brushes placed on the commutators on corresponding points at the ends of the pole pieces. The result is that with these combinations

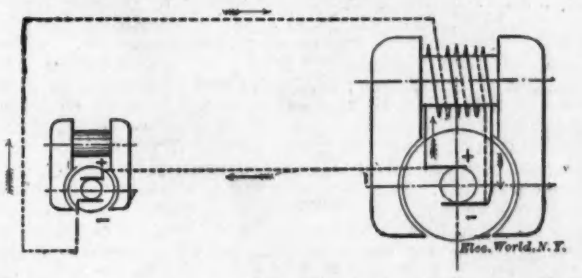


FIG. 5.

these points constitute the neutral points from which the proper current can be taken.

Electric Signaling Apparatus on the Northern of France Railway.

On the Northern of France Railway a very efficient electric apparatus is in use as a connection with the distant signals and the locomotives. On the road there is arranged a plate of considerable size; this is coupled with the distant signal in such a way that it rises when the signal is at danger, and is depressed when the disc shows "line clear." Upon the engine is a large and stiff wire brush. which sweeps over the surface of the plate when the latter is raised. An electric circuit passes from the terminal of a battery to the plate, thence through the brush to signaling apparatus on the engine, and from that to earth through

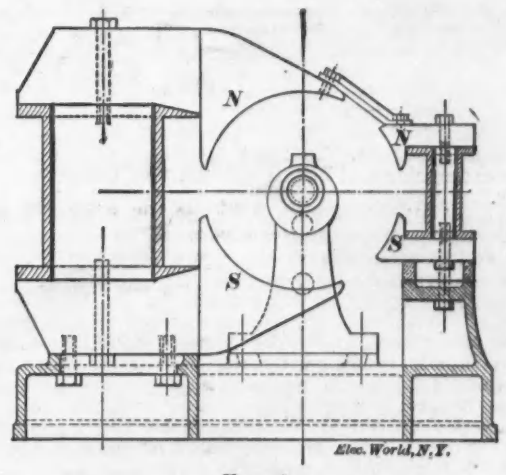


FIG. 6.

the rails. The brush is not a delicate piece of apparatus, but a solid construction, capable of sweeping snow off the plate and of scraping its way through a coat of ice. The whole appliance is said to give very satisfactory results.

Electrical Units Defined.

To the Editors of The Electrical World:

Kindly define the terms "Megohm" and "Ampère." An expert electrician informs me that the former is the unit of resistance and equal to 1,000 ohms, while "Webster's Unabridged" (1884) states it to being equal to 1,000,000 ohms. R. H. C.

JERSEY CITY.

ANSWER: A megohm is 1,000,000 ohms. The ampère is the practical unit of current, or such a rate of flow or transmission of electricity as would pass with an E. M. F. of one volt through a circuit whose resistance is equal to one ohm. See "Houston's Dictionary." We think our correspondent would do well to avoid all such idle controversies by procuring some good books on the subject and reading them carefully.—EDS. E. W.

On the Distribution of Electric Energy by Means of Constant Current.*

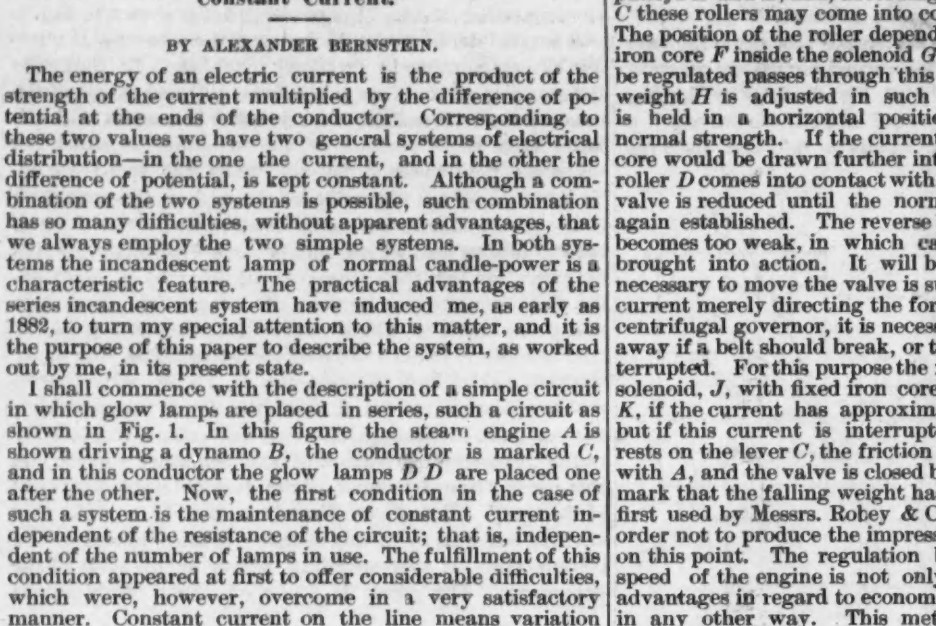
BY ALEXANDER BERNSTEIN.

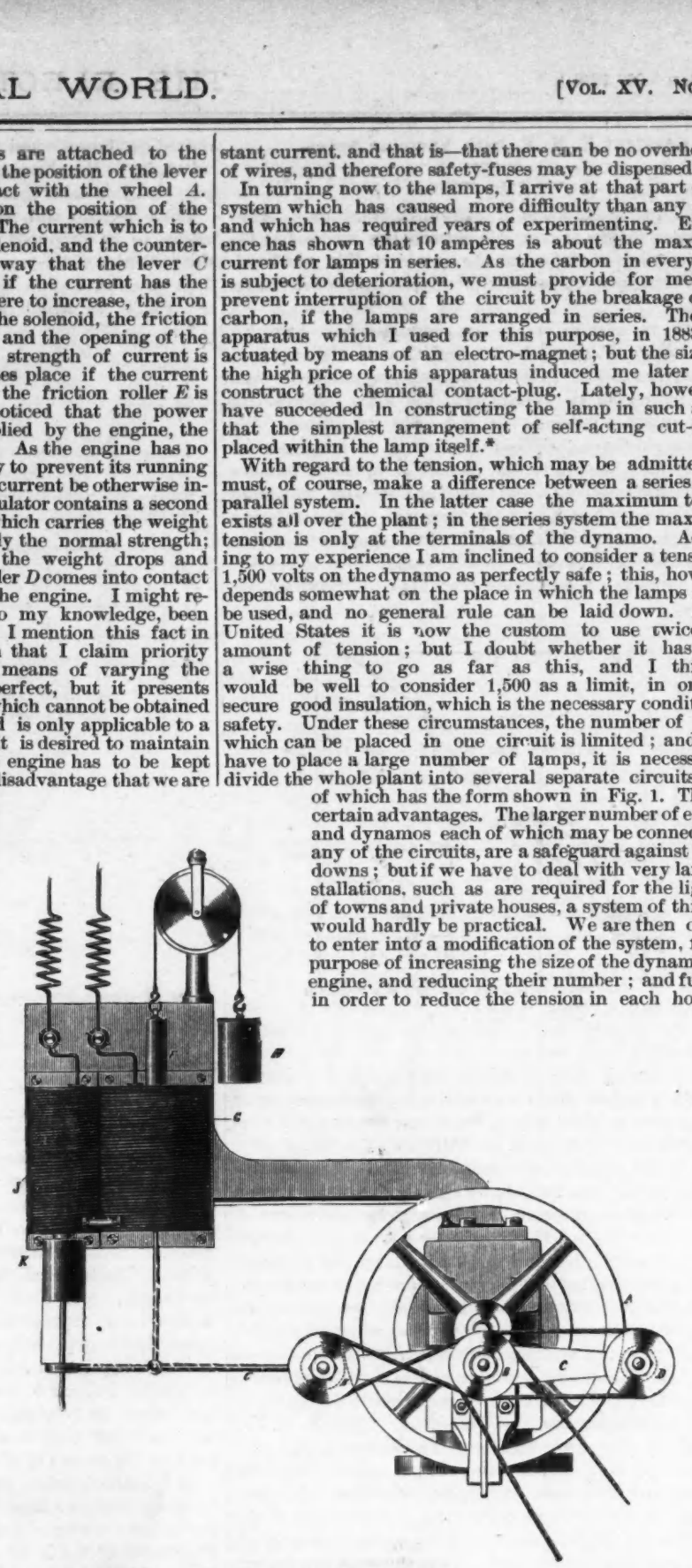
The energy of an electric current is the product of the strength of the current multiplied by the difference of potential at the ends of the conductor. Corresponding to these two values we have two general systems of electrical distribution—in the one the current, and in the other the difference of potential, is kept constant. Although a combination of the two systems is possible, such combination has so many difficulties, without apparent advantages, that we always employ the two simple systems. In both systems the incandescent lamp of normal candle-power is a characteristic feature. The practical advantages of the series incandescent system have induced me, as early as 1882, to turn my special attention to this matter, and it is the purpose of this paper to describe the system, as worked out by me, in its present state.

I shall commence with the description of a simple circuit in which glow lamps are placed in series, such a circuit as shown in Fig. 1. In this figure the steam engine *A* is shown driving a dynamo *B*, the conductor is marked *C*, and in this conductor the glow lamps *D D* are placed one after the other. Now, the first condition in the case of such a system is the maintenance of constant current independent of the resistance of the circuit; that is, independent of the number of lamps in use. The fulfillment of this condition appeared at first to offer considerable difficulties, which were, however, overcome in a very satisfactory manner. Constant current on the line means variation of E. M. F. in the dynamos according to outside resistance. Now, the E. M. F. of a dynamo can be varied in several ways—for instance, by variation of the magnetic field, or by altering the position of the brushes; but both these methods have their defects, and especially the latter, which is open to many objections. The much better way of altering the E. M. F. consists in varying the speed of the dynamo, and this method contains advantages which cannot be obtained in any other way. If a series dynamo is driven by a steam engine from which the centrifugal governor has been removed, then this combination has in itself a tendency to produce constant current on the line; this means that the steam engine will run fast if there are many lamps on the circuit, and will reduce its speed if the number of lamps is reduced. To most engineers this always appears so singular that I shall explain the action in a few words.

We are dealing here with a dynamo which has a field of constant intensity, and under these circumstances the E. M. F. and therefore the current produced is equal; outside resistance is simply dependent on the number of revolutions of the armature. The strain on the belt which is necessary to maintain the armature in rotation is dependent on the current, and quite independent of the E. M. F. This strain is produced by the pressure of the steam; therefore, if the steam pressure is given, the strength of current in the armature is determined which will counterbalance this pressure on the piston. I shall suppose that a state of equilibrium is maintained if the steam engine makes 100 revolutions, and the current is equal to ten ampères. Now, if lamps are added, the outside resistance would increase, and therefore the strength of the current would be diminished. This has the effect of disturbing the equilibrium; the current is too weak to counterbalance the steam pressure, which we assume is constant, and the engine commences to move faster until equilibrium is again produced; this is as soon as the current has again reached 10 ampères. The reverse would take place if we diminish the number of lamps on the circuit. If we, therefore, use a steam engine without centrifugal governors, driving a series dynamo, we can obtain constant current in the circuit, provided that the steam pressure in the cylinder remains constant. This method of regulation was first put to practical use by me about three years ago, and has since then been adopted by others. As, however, the pressure in the cylinder cannot be relied upon as constant, and as this pressure, moreover, varies with the speed of the piston, it becomes necessary to use an electric regulator, in order to correct the irregularities in current which would otherwise result. I shall first describe the construction of the regulator which I am now using.

The regulator, Fig 2, contains a well-balanced steam valve moved by a spindle, which carries the friction wheel *A*. A small rope pulley *B* is situated underneath the shaft of the friction wheel *A*, and this pulley is kept revolving from the shaft of the engine. The shaft of pulley *B* carries a lever *C*, which contains the bearings for two small pulleys *D* and *E*. These pulleys are connected in such a way with *B* that one is driven by an open, the other by a crossed belt. Small friction rollers are attached to the pulleys *D* and *E*, and, according to the position of the lever *C* these rollers may come into contact with the wheel *A*. The position of the roller depends on the position of the iron core *F* inside the solenoid *G*. The current which is to be regulated passes through this solenoid, and the counterweight *H* is adjusted in such a way that the lever *C* is held in a horizontal position if the current has the normal strength. If the current were to increase, the iron core would be drawn further into the solenoid, the friction roller *D* comes into contact with *A*, and the opening of the valve is reduced until the normal strength of current is again established. The reverse takes place if the current becomes too weak, in which case the friction roller *E* is brought into action. It will be noticed that the power necessary to move the valve is supplied by the engine, the current merely directing the force. As the engine has no centrifugal governor, it is necessary to prevent its running away if a belt should break, or the current be otherwise interrupted. For this purpose the regulator contains a second solenoid, *J*, with fixed iron core, which carries the weight *K*, if the current has approximately the normal strength; but if this current is interrupted the weight drops and rests on the lever *C*, the friction roller *D* comes into contact with *A*, and the valve is closed by the engine. I might remark that the falling weight has, to my knowledge, been first used by Messrs. Robey & Co. I mention this fact in order not to produce the impression that I claim priority on this point. The regulation by means of varying the speed of the engine is not only perfect, but it presents advantages in regard to economy which cannot be obtained in any other way. This method is only applicable to a system of constant current; if it is desired to maintain constant potential, the speed of the engine has to be kept nearly uniform. Now, this has the disadvantage that we are only working economically if the engine is exerting its maximum power. With a certain steam pressure there is a certain degree of expansion at which the consumption of coal is a minimum. If we use this highest degree of expansion when the engine is doing its maximum work, we are often working against the pressure of the atmosphere if we reduce the power of the engine. This is very different from the above mentioned method of regulation; the velocity alone varies, the advantage of the expansion always remains the same. A steam engine of 100 h. p. consumes 15—20 h. p. in order to run at full speed without doing any useful working. This means 15 per cent. loss at full power, 30 per cent. at half power, etc.; in fact, all motors are very uneconomical if they have to maintain full speed without doing maximum work. A gas engine, for instance, consumes at half load five-sixths of the amount of gas which is required at full load. Lastly, the wear and tear remains about the same as long as the speed is the same; but if we adopt the method of varying the speed, the internal work and the wear and tear is about in proportion to the useful work, and we therefore secure an advantage which cannot be obtained in the system of constant potential. The construction of the dynamo offers no special difficulty; we have, indeed, to deal with the simplest conditions. The current in the field magnets and the armature remains constant, and under these circumstances the position of the brushes on the commutator never requires any alteration. This is a very important feature of the system. In fact, the further development of the system, of which I shall speak later on, would hardly be practicable without this peculiarity of the dynamo.





FIGS. 1 AND 2.—DISTRIBUTION OF ELECTRIC ENERGY BY MEANS OF CONSTANT CURRENT.

If I now turn to conductors, I arrive at that part of the series system which many electricians generally consider as the only advantage of it, but I believe this paper will show that the possibility of overcoming long distances with small conductors is only *one* of the practical advantages of the distribution of electrical energy by means of constant current. It is well understood that the expense of conductors in a series system is much below that required in a parallel system. To give an example: Supposing 100 lamps, each consuming 60 watts, have to be supplied with electrical energy at a certain distance from the dynamo; the lamps placed in parallel are to be each of 100 volts and 6 ampères; the lamps in series requiring 6 volts and 10 ampères. In this case the cross-section of the conductor for the parallel arrangement would have to be 36 times larger than that required to be used in the series arrangement, if the same loss of energy is to be allowed in the conductors. But, quite independent of the cross section, we can in the latter method always maintain constant current, independent of the number of lamps in use and the distance, while the difficulty of maintaining constant potential increases materially with the distance. There is another advantage which is peculiar to the system of constant current, and that is—that there can be no overheating of wires, and therefore safety-fuses may be dispensed with.

In turning now to the lamps, I arrive at that part of the system which has caused more difficulty than any other, and which has required years of experimenting. Experience has shown that 10 ampères is about the maximum current for lamps in series. As the carbon in every lamp is subject to deterioration, we must provide for means to prevent interruption of the circuit by the breakage of the carbon, if the lamps are arranged in series. The first apparatus which I used for this purpose, in 1883, was actuated by means of an electro-magnet; but the size and the high price of this apparatus induced me later on to construct the chemical contact-plug. Lately, however, I have succeeded in constructing the lamp in such a way that the simplest arrangement of self-acting cut-out is placed within the lamp itself.*

With regard to the tension, which may be admitted, we must, of course, make a difference between a series and a parallel system. In the latter case the maximum tension exists all over the plant; in the series system the maximum tension is only at the terminals of the dynamo. According to my experience I am inclined to consider a tension of 1,500 volts on the dynamo as perfectly safe; this, however, depends somewhat on the place in which the lamps are to be used, and no general rule can be laid down. In the United States it is now the custom to use twice this amount of tension; but I doubt whether it has been a wise thing to go as far as this, and I think it would be well to consider 1,500 as a limit, in order to secure good insulation, which is the necessary condition of safety. Under these circumstances, the number of lamps which can be placed in one circuit is limited; and if we have to place a large number of lamps, it is necessary to divide the whole plant into several separate circuits, each of which has the form shown in Fig. 1. This has certain advantages. The larger number of engines and dynamos each of which may be connected to any of the circuits, are a safeguard against breakdowns; but if we have to deal with very large installations, such as are required for the lighting of towns and private houses, a system of this kind would hardly be practical. We are then obliged to enter into a modification of the system, for the purpose of increasing the size of the dynamos and engine, and reducing their number; and further, in order to reduce the tension in each house to such an amount as can be considered safe for use in private houses.

We now arrive at the system of constant current with transformers; such a system is shown in Fig. 3. *A* is the steam-engine, which is provided with the electrical governor; *B* the dynamo; *C* the main conductors in the streets; and D_1, D_2, D_3, etc., the transformers, which are placed in the main conductors; E_1, E_2, E_3, etc., are the house circuits, in which the lamps or other apparatus are arranged in series again. It will be useful, first of all, to consider the peculiar conditions under which such transformers for constant current are situated, conditions which greatly increase the practical usefulness. A transformer consists of a combination of motor and dynamo, and it is, therefore, apparent that there might be as many modifications in the form of a transformer as we have now in dynamos. The engraving Fig. 4 is merely to illustrate the principle, and does not indicate the form in which I hope to show to you shortly the transformer in operation. In the engraving the armature of the motor, which is provided with thick wire, and the armature of the dynamo, with coils of thin wire, are entirely separated, and both move in a common magnetic field, which is excited by the current in the primary wire. The shaft of both armatures is situated in bearings which are provided with self-acting oiling arrangements. There are a variety of such arrangements already in use, and in this case the requirements of oil are very small, as there is no one-sided pressure on the bearings, and all the internal electrical forces completely balance themselves with respect to the shaft, so that the friction merely results from the weight of the small armatures.

Let us now consider the function of such a transformer.

The force which must be supplied in order to turn the primary armature under a field of given and constant strength, depends on the current in this armature. This current is kept constant by the means described above. This turning force is resisted by the current on the secondary armature, neglecting the small amount of friction. The current on the secondary armature, which is equivalent to this force, depends on the number of turns of wire on the secondary armature, proportional to the number on the primary armature. This proportion being given, the strengths of currents are determined which hold each other in equilibrium; or in other words, a constant current in the primary produces a constant current in the secondary

* Abstract of a paper read before the Electrotechnical Society, of Berlin.

* For illustrated description of the new Bernstein lamp and socket, see THE ELECTRICAL WORLD, May 4, 1889.

circuit. The E. M. F. of the secondary circuit depends on the number of revolutions of the armature, as the field remains constant. Under these circumstances the following will occur: If, for instance, the primary current is 50 ampères, and the armatures are wound in such a way that a current of 50 ampères in the primary armature is counterbalanced by a current of 10 ampères in the secondary armatnre, the transformer will assume the speed which produces the 10 ampères in the secondary circuit, because only then the state of equilibrium is obtained. Let us suppose that with 100 revolutions per minute, and a resistance of 10 ohms in cir-

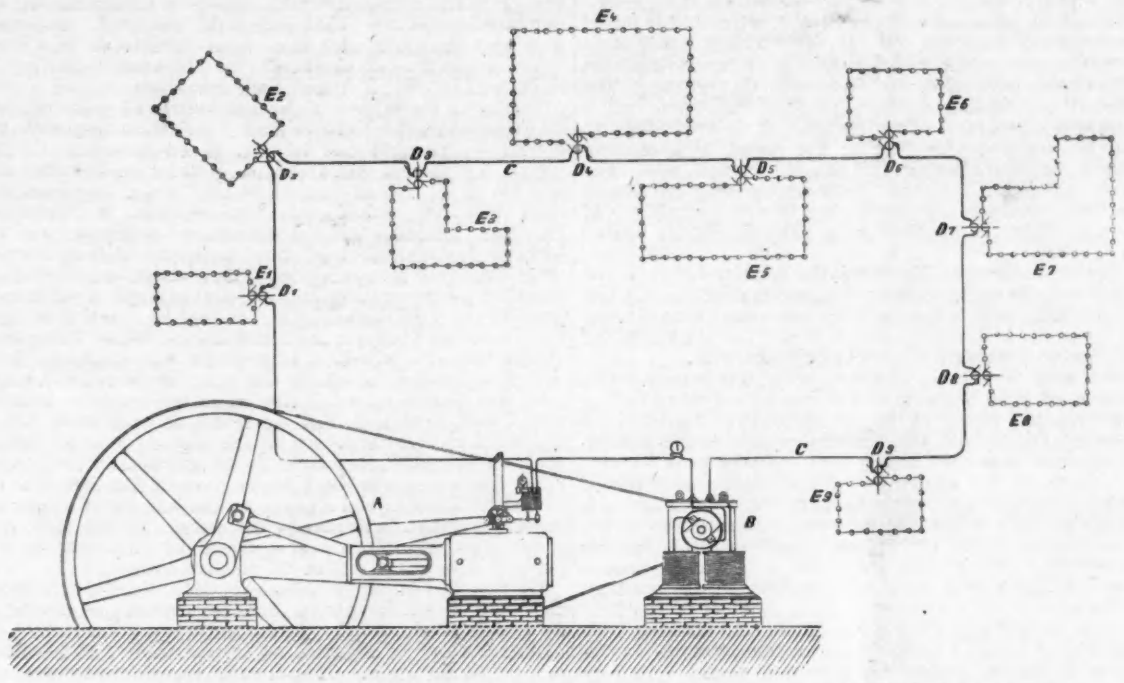


FIG. 3.—DISTRIBUTION OF ELECTRIC ENERGY BY MEANS OF CONSTANT CURRENT.

cuit, the E. M. F. is 100 volts. and therefore the current 10 ampères; if now by the addition of lamps the resistance is increased to 20 ohms, the velocity of the transformer must increase also, and now becomes 200 revolutions, in which case the E. M. F. is 200 volts and the current again 10 ampères. The reverse would have taken place if the number of lamps had been reduced. It, therefore, follows that the transformer in this case has the peculiarity of running at full speed if all the lamps are in use, and of reducing its speed according to the number of lamps which are extinguished. This peculiarity greatly diminishes the wear and tear, and is of considerable practical importance.

But there are other circumstances of equal importance which much favor the use of these transformers. In every transformer it is a necessity that the insulation between the primary and the secondary should be well maintained. This is very difficult in a parallel system, in which the high difference of potential, 1,000–2,000 volts, exists everywhere in the circuit, and, therefore, between the brushes of the primary armature. But in the case under consideration, the difference of potential on the commutator of the primary armature is only small. If, for instance, we require a power of 3,000 watts, this difference would only be 60 volts under the conditions assumed above. This makes it perfectly easy to maintain insulation, and, further, to prevent sparking at the commutator. I have already mentioned that the position of the brushes need never be altered in constant current dynamos; the same is, of course, the case in the transformers. These three peculiarities of the transformer for constant current, viz., the fixed position of the brushes, the small difference of potential in the primary armature, and the change of speed according to the requirements, allow this application of the transformer to be made on which this system is based, because an apparatus which works under so favorable circumstances may be left to itself for weeks, and a periodical, say monthly, inspection by an attendant is quite sufficient.

I have already explained that the speed of the transformer will vary according to the number of lamps; this point now requires some further consideration. The secondary armature moves in a constant field, and the E. M. F. is therefore proportional to the speed. The secondary current is constant because the primary is constant. It therefore follows that the number of revolutions of the transformer are a direct measure of the electrical energy which is consumed in the secondary circuit. As a meter, the construction of which has never yet received a satisfactory solution in the parallel system, we simply use a registering speed counter attached to the shaft of the transformer. This meter does not register exactly according to the number of lamps which are used, as it measures the total energy consumed, and this is higher in proportion if the number of lamps is small; but this is in accordance with the usual practice, only that in place of an arbitrary scale we have one which corresponds to the running expenses at the central station. It will hardly be possible to construct a simpler or more rational meter for electrical energy. It is of course, to be understood that every transformer is provided with a short-circuiting hand-switch, which cuts off the current from the primary armature in case no lights are required in the house.

I wish to add here a short remark concerning the alternating current transformer. Those who have advocated the alternating current system will undoubtedly say that the alternating current transformer is more economical than the one proposed here, and they will point to extraordinary results of efficiency which have been obtained by mathematicians; but in spite of these results, the commercial efficiency of these transformers is not any higher than can be expected. In fact, there is no reason why there should be any large difference in favor of the alternating current. The internal resistance is smaller in this kind of transformer, but there is against this the loss due to rapid change of magnetism in the iron. Supposing even that with full load there is a slight difference in favor of the alternating current, the probability is that with half the load the advantage will be on the side of the continuous constant current transformer, arranged in the manner which I have described, as against the alternating transformer in a parallel system.

I now turn to the consideration of the secondary circuit. In speaking of the simple-series system I have mentioned 10 ampères as the standard current; but in the transformer system we can use any current in the secondary which answers our purposes. If we have to deal with the lighting of private houses, in which lamps of 8 to 10 c. p. are required, we can use 5 ampères in the secondary, and we can then produce these lights with considerable efficiency, which it is well known is not possible with lamps of 100 volts placed in parallel. For large buildings 10-ampère lamps would be used, and we can then place arc lamps in series with them. In order to obtain a steady light in arc lamps, it is better to supply them with constant current than to put them into a circuit of constant potential. Furthermore, we have to waste considerable energy in resistance in the latter case. I need hardly mention that motors can be placed in the secondary circuit. There are many cases in which the use of accumulators is very desirable for lighting purposes. Probably we shall see charging stations for accumulators for the purpose of propelling street cars sooner or later established in large cities.

After considering all the various parts of the system, the construction of a central station plant is easily understood. I shall suppose we have to deal with a plant of 9,000 20 c. p. lamps, or a corresponding number of electrical devices requiring the same amount of energy. The central station contains seven dynamos of 2,000 volts and 50 ampères each, of which one is a reserve dynamo, and each one is driven by a separate steam engine. The whole district is divided into six separate groups, which form independent circuits. In each group 1,500 lamps may be in use simultaneously, and for the sake of simplicity I shall suppose that all transformers are of equal size, namely, each for 50 lamps; we then have 30 transformers in each circuit. If all the lamps are in use, all the engines, dynamos and transformers have automatically assumed their full speed. In the same measure in which lamps are extinguished in the single house circuits, the corresponding transformers will reduce their speed and react on the engine in the central station. If the consumption of light or power is reduced to a minimum, all the steam engines will have assumed a crawling motion, which they maintain until the consumption is raised again. All we have to attend to is the management of the plant, to keep steam, oil the bearings, and an occasional inspection of the transformer, which may be done by the same attendant who notes the consumption of energy in each house. Comparing this with the management of a station on the parallel arrangement, with a multiple number of conductors, the great simplicity is very apparent. In the latter case the approximation to constant potential is only obtained by the most careful attention at the central station for the purpose of regulating the supply of energy through each feeder, and the success is constantly dependent on the care which is bestowed on this regulation, besides the attention which has to be given to properly load each dynamo.

If, now, we sum up the advantages of a system of constant current, we can consider these to be mainly as follows: (1) The possibility of lighting at long distances, and therefore the placing of central stations outside large centres. (2) The economy in regulating the speed of the motive power according to the requirements. (3) The small amount of attendance which is required at the central station. (4) The cheapness of conductors in the streets and houses. (5) The avoiding of fire by overheating of wires. (6) The greatest efficiency of the lamp. To these we have to add all the other advantages to which I have alluded in my paper.

I have abstained from making any comparison with the alternating-current system, except when I spoke of the transformer itself, but I feel convinced that a system using continuous currents, and having the advantages of the alternating transformer system, must ultimately prove the superior of the two.

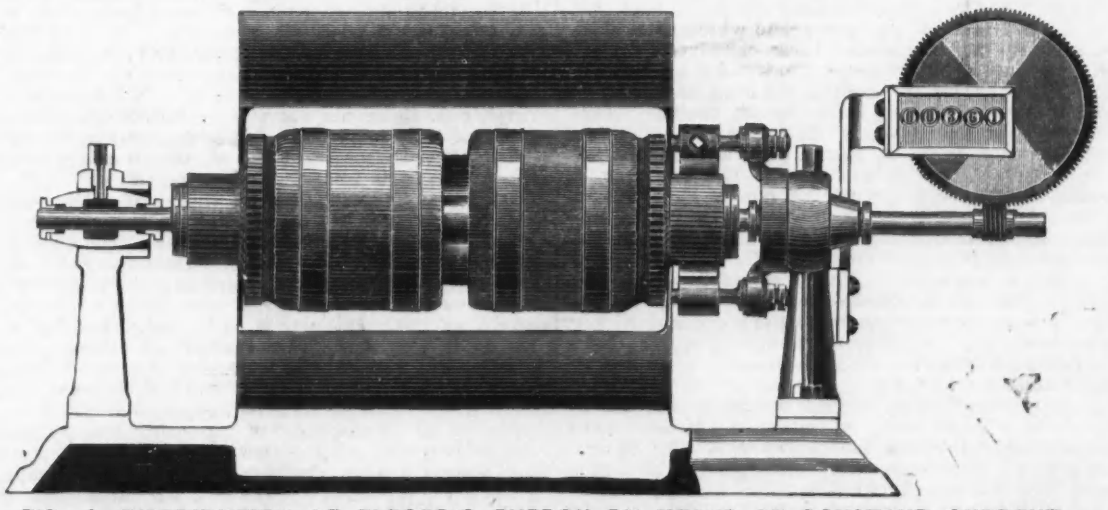


FIG. 4.—DISTRIBUTION OF ELECTRIC ENERGY BY MEANS OF CONSTANT CURRENT.

The Design of Commercial Transformers.

BY J. SWINBURNE.

IV.

Open Circuit Transformers.—We have seen that in closed circuit transformers the magnetizing current is small. Though the power wasted in the iron may be considerable, the power wasted on the copper of the primary coil by the magnetizing current is negligible. If we take a transformer with a single copper link, and replace the iron link or links by a short iron core of the same section, we reduce the loss in iron to about one-quarter, assuming the same induction in the core. But in order to get this induction the exciting current would be enormous, and this would cause an extra waste of power in the copper of the primary coil, which would very much more than compensate for the reduction of the loss in the core. Of the total excitation needed, very little is spent upon the iron core; nearly all is spent on the air through which the lines of induction have to pass.

To overcome this difficulty, I have designed a form of open circuit transformer in which the iron core is small, so that there is not much loss in it, and it is spread out at each end into a sort of thistle-head, so that the induction in the air is not high anywhere. The exciting current is still much higher than in a closed circuit transformer, but the loss in the primary due to it is much less than the extra loss in the iron needed to complete the iron circuit. Fig. 13 is from a photograph of the active part of a 20-light hedgehog transformer.

As in the example taken in the beginning of these articles, neglecting the resistances of the coils, the secondary and primary electromotive forces, and, if the transformer is working on simple resistance, the secondary current, vary together. The primary current, however, may be split up into two components—the active current, which is transformed into the secondary, and which gives the same ampère turns as the secondary in the opposite direction at each instant, and the current which is devoted to producing the induction in the air and iron, or the exciting current. At any instant part of the excitation is spent in magnetizing the core, and part in producing the induction in the air. The excitation may be thus split up into two components. The whole primary current may be thus regarded as compounded of three currents differing in phase and different functions of the periodic time. Leaving the question of loss by copper resistance out of the question for the moment, the power given to the transformer in the form of the active current under the primary electromotive force is, of course, all given out again by the secondary. The current devoted to magnetizing the iron is less than a quarter of a period behind the primary electromotive force, so power is taken up and given to the iron. The magnetizing current is just as in the case of a closed circuit transformer, but as there is less iron it is less, and less power is spent. The current devoted to producing the induction in the air lags a quarter of a period behind the electromotive force, so it absorbs no power.

Turning now to the loss in copper, that of the secondary is obtained, as before, by multiplying the square of the effective current by the resistance. The loss in the primary is more complicated. The loss in copper due to the magnetizing current is so small that it may be neglected, so that we may take the part of the exciting current spent on the air as the whole exciting current, and find the loss of power due to it and the active current. We have thus to find the loss of power due to two currents differing in phase, and varying differently, or, referring to graphical methods, having different curves. The excitation current is at any instant proportional to the time integral of the electromotive force. Taking a simple case, in which the transformer works on resistance, so that the electromotive force and active current agree in phase, and assuming the electromotive force curve, and therefore the current curve, to be symmetrical, we may consider half a period at a time, and divide it into two quarter periods. The excitation current is at its maximum when the active current is at zero. The power at that instant is zero. At any instant, i, before this in the half period the active current is, say, c, and the exciting current, say, γ, and the power spent on

the copper of resistance, R, is $R(\gamma + c)^2$. At an instant, k, just as long after the maximum point of exciting current as the first was before it, the active current is $-c$, and the exciting current γ; so the power at that instant is $R(\gamma - c)^2$. The whole of the half period may be divided up into similar corresponding seconds. The mean power in each pair of instants is $R(\gamma^2 + c^2)$, so that the effective current is $\sqrt{(c^2 + \gamma^2)}$. That is to say, the loss in copper is as if each current acted independently. If two direct currents of two ampères each were passed against a resistance of an ohm, each would develop four watts by itself, but together they would develop 16 watts. But if an active and exciting current of the transformer under consideration were taken, each would give 4 watts, and together they would only give 8 watts. We have here assumed the curves to be symmetrical. If they are not, instead of finding the power at corresponding instants, we must find the energy wasted in corresponding areas of the electromotive, or active current, curve. Referring to Fig. 14, the energy wasted during the time represented by the breadth of the first slip is, calling the area c, $(c + \gamma)^2$, and as the area of the corresponding slip is equal the energy wasted then is $(c - \gamma)^2$, so that we have the same result as before. We thus see that whenever there is no hysteresis, whatever the primary electromotive force and current curves may be, if the exciting current is the same function of the electromotive force in rising as it is in falling, the loss of power in the copper may be taken as if the exciting current and active current were in separate independent circuits. The effective current due to both is not obtained by adding the effective currents together, but by adding their squares and taking the square root of the result.

As an example of an open circuit we may take a 3,000 watt hedgehog transformer, and work out the efficiency. The exciting ampère-turns depend on the dimensions of the transformer, and the size and current density of the primary depend partly on the excitation current, and these quantities are involved in such a way that a calculation to find the best form for a given case gives three complex and unmanageable simultaneous equations. It is much quicker to find the best form by trial, altering one dimension at a time, as independent variable till a good result is obtained. To get the excitation current, or the primary current at no load, the bushy end is taken as having a hemispherical surface, and the direction of the induction in the air is taken as radial, whereas it really curves round on all sides to the other hemispherical surface. The magnetizing current is thus slightly overestimated. The primary current is taken as the root of the sum of the squares of the magnetizing and the main current. Calling the diameter of the core w, the length of the coil and straight part of the core t, the thickness of winding z, and the radius of the hemisphere y, the magnetizing ampère turns per cubic centimetre of iron h, the total excitation needed is

$$h(t + 2y) + \int_y^\infty \frac{B_v \, w^2 \, 64 \, dy}{10 \pi y^2}.$$

The first term may be neglected. Taking an induction of 10,000, and w as 5.5 centimetres, t as 25 centimetres, and y as 8 centimetres, an efficiency of 96.2 per cent. will be obtained. These dimensions have been worked out to give the highest efficiency at full load. Of the 3.8 per cent. loss, most is in the copper, and is due to the secondary current and the primary active current, so that at light loads the loss is very low. The best closed circuit transformer of this output can only give 95.2 per cent. efficiency at full load. Running at full load two hours a day, this only gives an average efficiency of 74.7 per cent. The open circuit form gives 77.3 per cent. under these circumstances. It will be found that for all loads open circuit transformers can be made to give higher efficiencies than closed, unless the maximum output is small. In large transformers the exciting current is not so large in proportion, so open circuit transformers are still more efficient in comparison.

Instrument Transformers.—These are little transformers for making a given instrument available on any circuit. For instance, unless a very sensitive, or a charged, electrometer is used, it is difficult to read under 100 volts. But as the force on the moving part varies as the square of the electromotive force, it is easy to make an electrometer to read with a few thousand volts, and to provide a little transformer. The transformer must have a closed iron circuit, and it will be found that where such high electromotive force is needed in one coil, the insulation of the wire takes up so much room that the transformer occupies about 3-inch cube, or from 20 to 30 cubic inches. There is nothing calling for special treatment in the design of these little transformers. They absorb something like 10 watts. They are sometimes used for transforming down, so that a high tension circuit is read on a 100-volt hot wire instrument. This is not a good arrangement, because the waste of power in the instrument and transformer is then considerable, and a hot wire voltmeter is not nearly so accurate as an electrometer, as it has two temperature errors, for only one of which is there ever compensation. Transformers to work very low tension instruments, for instance, converting from 100 to 10, can be made more easily, as the wires are thicker, and the insulation less in proportion. Of course, this is not accurate either unless the instrument is compensated for both temperature errors.

It has also been proposed to measure large currents by transforming up, and using a voltmeter. If each main circuit is strung through the centre of a ring of iron wound with a fine secondary, a voltmeter can be used to measure any of the main currents. This method does not admit of great accuracy, because there is no definite relation between the primary current and the secondary current or electromotive force. The secondary current would vary as the back electromotive force of the primary, not as its current. It could only vary as the primary current if the iron had practically infinite permeability and no hysteresis. In a closed circuit the hysteresis causes error; in an open one, want of permeability, which involves a large exciting current, and also causes errors.

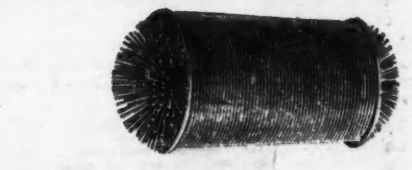
Induction Couplers and Choking Coils.—Choking coils were invented by Dr. John Hopkinson in 1881, and both choking coils and induction couplers were proposed by him for coupling alternaters in 1884. I take this opportunity of stating this, as I recently brought induction couplers forward as an invention of my own, without knowing Dr. John Hopkinson had done so more than three years before. Induction couplers are obviously easy to design. They may have plenty of iron, as it is not magnetized unless the machines are getting out of step. A choking coil is like a transformer, but has only one circuit, so that when put in series with any work, it gives a back electromotive force, which checks the current without corresponding waste of power. Thus a 50-volt arc lamp can be run off a 100-volt circuit without the waste of power that would take place with resistance, and with the same effect as to steadiness. The arc lamp really uses the exciting current of the choking coil. Choking coils seem always to be designed with closed iron circuits. This is wrong, because if there are many turns of wire the iron gets magnetized so highly that the loss by hysteresis is enormous, and the choking coil gets hot; or, if there are few turns, the coil does not give back enough electromotive force. For instance, if a 50-volt 10-ampère arc lamp were to be run off a 100-volt circuit, and the choking coil had a core which at a reasonable induction gave one volt per turn of wire, and if it had to give back electromotive force of, say, 87 volts, it would require 800 ampère turns, which would give far too high an induction, unless the iron circuit were made very long. The iron circuit should therefore be open, and the whole coil is then quite a small piece of apparatus. It is impossible to give an accurate rule for finding for what back electromotive force the choking coil should be designed. For instance, a choking coil that took an exciting current of 10 ampères when put by itself on a 50-volt circuit would take more than 10 ampères on a 100-volt circuit with 5 ohms in series.

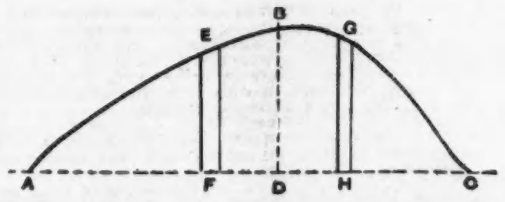
In the transformers discussed, the relation between the exciting and the main current does not matter much; but as in a choking coil we are wholly concerned with the exciting current, a difficulty arises if we do not know the electromotive force of the current to begin with.

In the case of a curve of sines the matter is easy. If a resistance of five ohms is to have an effective current of 10 ampères, the curve of the electromotive force on the resistance, and thus of the current, which is also the exciting current, is at once determined. As the back electromotive force of the choking coil is a quarter of a period behind this current and electromotive force, a value for it is found, so that when the two electromotive forces are compounded a curve giving an effective electromotive force of 100 volts is obtained. The transformer is then designed to give this back electromotive force with an effective current of 10 ampères. It is difficult to say how far wrong results so obtained would be. As choking coils are generally made adjustable, of course accuracy in design is of little importance, and a random assumption may give results near enough for actual practice.

The Electrical Progress of the Year.

At the last meeting of the New York Electrical Society, held on Jan. 11, Mr. Joseph Wetzler delivered his annual lecture on "The Electrical Progress of the Year." The





FIGS. 13 AND 14.—TRANSFORMER CONSTRUCTION.

speaker opened his lecture by remarking that next in importance to the acquisition of additional knowledge is the rehearsing and fixing in our minds of that which we already know, or think we know. He proposed to review what had been done, with the second object in mind. Beginning with the primary battery, the oldest source of electrical energy, the lecturer described the various modifications which have been made in the gravity cell by Delany, who encases the zinc and the sulphate of copper in paper envelopes, and by Gethins, who employs the gravity principle reinforced by a porous partition at the line of junction of the two liquids in the gravity cell. Reference was also made to the improved form of the Lalande copper oxide cell brought out during the past year by Mr. Edison, and the excellent results obtained with it, due to its remarkably low resistance.

Passing on to storage batteries, Mr. Wetzler remarked that improvements in this branch have been somewhat retarded, as compared with former years. He drew attention, however, to the Lugo cell, in which the gases, oxygen and hydrogen, formed by the decomposition of the electrolyte, were actually stored in the plates, which are prepared so as to permit of this. Reference was also made to the new system of storage battery distribution, and to the excellent résumé of the subject of battery regulation by Mr. G. B. Prescott, Jr., before the American Institute of Electrical Engineers. The device by Mr. Pfatischer for regulating the potential of storage batteries of sub-stations entirely apart from the main station was also described. This end is accomplished by the aid of a polarized relay and the momentary interruption of the charging circuit which served to operate the proper regulating devices. Reference was also made under this head to the electrical sewage purification process of Webster.

In telegraphy, the lecturer drew special attention to the development of synchronous multiplex transmission, and called on Lieut. Patten, who was present, to describe his new system of multiplex telegraphy, by means of which 24 messages can be transmitted, and in which synchronism is maintained by means of alternating current motors running in unison. Mr. Wetzler also explained the telegraph line adjuster of Mr. P. B. Delany, in which by breaking the line for an instant at both ends simultaneously there is no possibility of an operator breaking in on the line in bad weather and delaying business, which frequently occurs in bad weather and on leaky lines. The Delany automatic perforator, intended for automatic transmission, in which perforations are made directly by means of apparatus worked by a Morse key, was also described.

On the subject of telephony, Mr. Wetzler drew attention to the remarkable experiment carried out by Mr. W. J. Hammer, between New York and Philadelphia, in which speech recorded on the phonograph in New York was immediately repeated by a carbon transmitter, then transferred over a line to Philadelphia, and, acting upon a motograph receiver, was reproduced in a second phonograph, again repeated by the carbon transmitter, transmitted to a local motograph receiver, and then reproduced to the audience. Reference was also made to the loud-speaking telephone by Mr. Charles Selden, in which it was sought to increase the volume of sound by causing a receiving electromagnet to act upon armatures attached to the pistons in the cylinder, the motion of which caused the condensation and the rarifaction of the air in the cylinder, which, acting on a diaphragm, gave increased sound over that ordinarily obtained. Attention was also drawn under this head to Mr. J. J. Carty's views on electrostatic induction on telephone lines and the important bearing it has on their operation.

Taking up the subject of the distribution of electricity and its generation, the lecturer first referred to the calelectric generator, brought out by Mr. E. G. Acheson, of Pittsburgh, a year ago, and drew the connection between that and his more recent one in which by the application of heat to the transformer its output is increased. In the systems of distribution referred to the lecturer described that of Doubrava, in which condensers were employed in connection with a continous current dynamo at the generating station, the current of which was periodically interrupted by a "disjuncter," which charged the condenser placed in the distributing circuits. Lieutenant Patten was also called on to describe his system of three-wire distribution, in which the positive impulses are sent over one outside wire and the negative impulses over the other, but both returned over the central wire. With this method every type of alternating current apparatus could be operated, including converters and motors; constant magnetism for the field magnets of the latter is obtained by winding the circuits connected to the opposite outside conductors in reverse direction. At the same time continuous current apparatus could be employed in connection with either one of the circuits alone.

On the subject of transformers, Mr. Wetzler referred to the work of Mr. Swinburne on open circuit transformers, as exemplified in his "hedgehog" type, for which he claimed a larger average efficiency than for the closed circuit transformer. The Paget transformer was also referred to, in which, by suitable mechanism, the magnetic circuit can be opened and closed in direct proportion to the load. Mr. Wetzler also cited Mr. Mordey's experiments on alternating current machines, and Prof. Elihu Thomson's ingenious method of obtaining constant alternating current, which he accomplishes by means of a bridge formed by an air space in a transformer of special design. The lecturer also described the various ways devised by Mr. Tesla for obtaining continuous from alternating current without a commutator. Among the continuous current apparatus described was the new Edison marine dynamo having eight poles, the four north poles being on the outside of the ring and the four south poles on the inside. A single exciting coil is employed, and the whole machine is very compact. Reference was also made to the proposed methods of obtaining light without heat.

Coming to the subject of motors, the lecturer called upon President Crocker to explain his new system of motor regulation developed in connection with Dr. S. S. Wheeler, and also upon Lieut. Patten to describe his alternating current motor, and then proceeded to describe various improvements that have been made in electric coal mining machinery, tree-felling machines, and the various application of motors to railways, together with the principle recently announced by Mr. Tesla as to the maximum capacity of motors. Among the measuring instruments brought out during the year, Mr. Wetzler described the Blyth electric torsion balance, the Ayrton & Perry twisted strip voltmeter, and Mr. Pfannkuche's method of measuring the strength of the alternating current by means of a thermopile arrangement in which the heat in a part of the conductor applied to one side of the junctions caused the generation of a current which can easily be measured. The lecturer also described the method of Prof. Elihu Thomson of effecting the generation in a secondary coil of a current which shall be equal to the square root of the current in the primary. This device is used in connection with the oscillating electric meter, in which an arm is vibrated by the alternate evaporation of a volatile liquid contained in two bulbs which enclose wires that are heated. Ayrton & Perry's method of studying alternating currents by means of vibrating strings was also described by the lecturer. Among the miscellaneous topics brought out, reference was made to the experiments of Mr. Kennelly on the resistance of the human body, which he has shown to be considerably lower than is generally supposed, and also to Mr. Kennelly's classical experiments on the heating of conductors by the electric current. The lecturer also passed in review the work of Hopkinson and Thomson on the recalescence of iron, and a number of minor improvements which have been made during the year.

At the close of the lecture Prof. George Forbes made some interesting remarks on the necessity of keeping up with the current progress, in which America figured so prominently at present, especially in all that pertained to electric motor work.

The Abolition of the Duty on Copper.

The following was presented on Jan. 16:

Petition to the Honorable Committee on Ways and Means, House of Representatives, U. S. A.

The subscribers were appointed a committee to petition your honorable body for the abolition of duty on copper ingot, plate, bars, rod, and wire. We represent the National Electric Light Association, a body composed of representatives of electric lighting companies throughout the United States, and also of manufacturers of, and dealers, in electric lighting apparatus and supplies.

The resolution appointing this committee was passed without a dissenting voice. We therefore have the honor to present this petition, earnestly requesting that the action asked be taken as a measure which will be approved by the great body of users and manufacturers of copper.

CHARLES A. BROWN,
GEORGE M. PHELPS,
J. F. MORRISON.

The address of Mr. Phelps in presenting the petition was as follows: The National Electric Light Association consists of corporations, firms and individuals owning and

operating stations and plants for the distribution of light and power by electricity.

At the time of the last convention of the Association, Aug. 6, 1889, the capital then invested in the industries above named was estimated, from statistics collected by the Secretary of the Association, to be no less than $275,000,000. That sum represented mainly electrical apparatus and electric conductors for the supply of 238,000 arc lamps and 2,700,000 incandescent lamps, in all of which apparatus and conductors copper is an indispensable and chief material. In the total cost of electric plant for light and power distribution it is estimated by competent experts that from one-fourth to one-third is expended for copper.

The foregoing figures and statements sufficiently indicate the magnitude of the interest of electric light and power companies in the price of copper.

In the opinion of the petitioners the proposed abolition of the copper tariff does not touch the question of protection to American industry. The duty on copper appears to be wholly superfluous as a protection to American producers of that metal. The United States not only produces more copper than it consumes, and consequently exports that metal, but it possesses the richest and most easily worked copper mines in the world, and its mining companies produce the metal and put it in the market at a lower cost than is possible to the Spanish or Chilian miners. Obviously, the American producers of copper require no duty to protect their domestic market, and their exports of copper furnish sufficient evidence of their ability to meet competition in foreign markets.

The existing duty is of no appreciable value to the National Treasury because copper is not imported in any considerable quantity. As a source of national revenue the copper tariff is practically useless, and the returns from it could not be increased materially under the conditions of production throughout the world by any modification of the rate of duty, if the government needed increased revenue, which it confessedly does not.

It would appear, therefore, that the duty on copper can only be efficient in enabling the mining companies and dealers in copper to establish and maintain excessive prices through combination for that purpose. It is believed that the United States duty of four cents per pound was a considerable factor in the operations of the syndicate established in France in the autumn of 1887 and which syndicate, aided by its agreements and contracts with copper mining companies in this country, succeeded in controlling the copper production and markets of the world for more than a year, doubling, for a considerable period, in London and New York, the price existing just previous to the beginning of its operations. This was effected, moreover, in the face of a superabundant supply of the metal. For some months after the breakdown of the French speculation, the American companies maintained the price in this country considerably in excess of that of European markets.

Touching the relation of the duty on copper to combinations for maintaining excessive prices, the following quotation is subjoined from the New York *Tribune* of May 16, 1889:

"The mine owners have publicly stated that they are able to produce more than all the copper this country consumes, and a large part of it at a cost not exceeding 9 cents per pound, and that they propose to the French bankers, who hold an enormous unsold stock, to fix the selling price at about 13 cents per pound—more than double the cost. Nothing need be said about the right of the producer to get a profit of more than 100 per cent. on his copper, provided he is not a beneficiary of a national policy intended to protect and encourage American production. But the mine owners are beneficiaries of that policy, and owe to the public a certain consideration and service in return. If they enter into a combination for the benefit of foreign speculators and bankers against the interests of American producers, the duty on copper may not last long. . . . There will, in all probability, be a revision of the tariff next winter. The party in power, being anxious to defend all industries that need and merit defense, will, for that very reason, be more strongly pressed to cut off duties where no defense appears to be needed, or where it seems to be not deserved. Combinations of speculators to corner the markets of the world are not highly popular and will not appear to members of Congress to merit particularly favorable consideration. Under such circumstances, the demand for a removal of all duties on copper ore, pig and bars will be difficult to resist. It is safe to say that, had the Mills bill proposed no change more unpopular or unobjectionable than that, its public support would have been incomparably greater."

In short, and to recapitulate, in the opinion of the National Electric Light Association, the duty on copper, being useless for revenue and unnecessary for protection, should not be suffered to remain on the statute books of the United States, since its only remaining function is to serve as an ally to the promoters of combinations for putting up prices, a process to which the government should not lend its assistance.

Report of the New York Board of Electrical Control.

The third report of the Board of Electrical Control of this city has been submitted to the Governor and Legislature, containing the record of the work accomplished by the Board during the past year.

After reciting the history of the Board and its work up to Jan. 1, 1889, the report continues:

The Work of the Board.

The following table shows the construction of subways to date:

Service.	Miles Trench.	Miles Duct.
Telephone and telegraph	28	503
Electric light	29	454
Edison	16	50
Subsidiaries		10
Total	73	1,017

This construction will accommodate approximately 45,000 miles of telephone and telegraph wires and 2,000 miles of electric light wires.

The Removal of Poles and Wires.

On all the streets and avenues the companies whose wires have been provided for have been directed to remove their poles and wires from the surface within 90 days, and at the expiration of that time, in case they are not so removed, it becomes possible and proper for the local authorities to remove them forthwith.

As has been stated, no removals were made under this provision of the act up to a very recent date, by reason of the apathy of the local authorities and the lack of co-operation on the part of the chief executive officer of this city until the beginning of the year 1889, and subsequent to that, owing to the injunctions procured by certain of the electrical companies.

The following table shows the poles and wires which have been removed as the result of work of the Board, either by the companies or by the Bureau of Incumbrances of the Department of Public Works.

	No. of poles.	Miles wire.
By companies	1,765	2,788
By Department of Public Works	3,007	2,827
Total	4,772	5,615

Subways and Underground Conductors.

The following table shows the number of miles of electrical conductors now in the subways, and the companies by which they are owned or operated:

Name of company.	Number of miles of underground wire.
Metropolitan Telephone	10,906
Western Union	578
Postal Telegraph	35
United States Illuminating	88
Brush Electric Light	38
Manhattan Electric Light	67
Harlem Electric Light	10
Mt. Morris	2
Edison	252
New York Fire Department	332
Total	12,308 miles.

In addition to this underground wire some 2,000 miles of telegraph wire are being operated in cables on the elevated railroads under permits of the Board.

The principles which have been followed in inaugurating the underground system may be defined as follows:

First.—A conduit or subway for electrical conductors is nothing more than a mechanical protection for the wires within it, and a convenience for placing and protecting them underground.

Second.—Electric light and power conductors should, as a matter of precaution and not of necessity, be operated separately, and as far as possible from those for the transmission of currents of lesser intensity.

Third.—The material and form of the subway should depend largely upon the requirements of the locality and the service for which it is designed.

Fourth.—Drawing-in-and-out conduits with convenient manholes are, in the main, the most desirable for the streets of this city, where a condition of the law allowing companies 90 days to place their conductors in the subways after they are constructed, necessitates that the subways shall be easily accessible without serious disturbance of the pavement.

Fifth.—The success of the underground service depends largely upon the proper insulation of the wires, and the largest liberty compatible with the preservation of the rights of others should be allowed to the companies making use of the subways.

Sixth.—The nature of local connections depends to a great extent upon the service and locality for which they are designed, and here, again, the liberty of choice under proper restrictions may reasonably be allowed.

Proceeding from these general principles, the board has constructed subways in different localities largely differing in design, size and material; and time and experience only serve to strengthen the board in its convictions and confirm its conclusions as correct.

In order that the statements contained above as to the sufficiency of the subways already constructed under the direction of the Board of Electrical Control may be substantiated by sworn testimony of those competent to judge of matters of this kind, affidavits are appended, sworn to by Mr. J. P. Barrett, the city electrician of Chicago; Mr. J. Elliott Smith, the superintendent of the New York City fire department telegraphs; Mr. Sunny, president of the Consolidated Arc Lighting Company of Chicago, and others, showing that the provisions for underground electrical conductors of the city of New York represent the best and most complete knowledge and experience of the subject.

Effect of Escaping Steam.

In a portion of the city, where the steam heating company maintains an imperfect construction and allows steam to escape in large quantities from its pipes, serious damage to the electrical conductors in the subways has been caused.

This has been made the ground of an attack upon the system of subways laid in this city, and opponents of underground wires have not hesitated to assert that, because of this impairment of the efficiency of the cables where the steam was allowed to escape into the streets, the entire construction of conduits for electrical conductors is a failure.

The steam heating company is at present endeavoring to stop this escape of steam from its pipes in the localities referred to, and has expended up to the present time more than a quarter million dollars in repairs of defective construction. Should it succeed in remedying the defects, the subways in the locality will again be effective. Otherwise the steam heating company must either rebuild or cease from using this section of its plant.

In other localities of the city where the construction of the steam heating company is proper, and steam does not escape, the existence of the steam pipes in the same streets with the underground wires has no effect upon the latter.

The frequent explosions of illuminating gas escaping from leaky mains into subways, sewers and house-vaults, is a matter which requires attention.

Electrical Connections.

In the matter of making electrical connections with the subways when constructed, the Board does not see good reason for departing from its original position of allowing the Construction Company to furnish whatever the several companies desire for themselves from the manholes to the points desired to be reached.

As soon as the subways are prepared along any street or avenue "sufficient in the opinion of the Board, reference being had to the general direction of the wires in use overhead," for the accommodation of the different electrical service, a notice is sent to the company operating such wires.

The way in which this resolution is drawn practically allows the companies operating wires to select their own methods of local distribution, while, at the same time, the authority of the commission over the Construction Company and its work, as well as the supervision of the Construction Company itself over the underground accommodations, is preserved.

This plan has been taken advantage of by some of the companies, and promises beneficial results. For example, the Construction Company has in some instances employed the hand-hole system of distribution for the use of telephone wires in down-town streets where it seemed desirable; while at other points a single entrance into a block, in connection with house-top distribution, has proved sufficient. Again, in portions of the city where it seemed desirable, and where companies have requested it, the hand-hole system of distribution for electric lights has been provided, while in other streets where no local distribution is needed, accommodation for trunk lines only is considered sufficient.

To permit the various companies each to select its choice from among the many modes of distribution, and then to determine whether or no the choice is proper, and, if such choice be not proper or be not made, to prescribe a method, is not only entirely within the limits of authority of the Board, but for the direct benefit of the electrical companies as well.

The Condition of the Wires Overhead.

It is found that the condition of the overhead wires in the city is very bad. The rules of regulations of the Board of Electrical Control are violated everywhere. Unnecessary and "dead" poles and wires make up from thirty to fifty per cent. of all those existing. The poles made use of and the method of construction, as well as the way in which the wires are strung, are not in accordance with proper principles, nor in harmony with the character of the buildings along the streets, nor of a description enabling the freest possible use of the streets for other purposes.

On the contrary, the wires are almost uniformly dangerous, especially those devoted to the electric light service. They obstruct the Fire Department; the poles are found duplicated by other lines alongside of them where one line would be ample for the business of both. The wires cross streets and enter buildings irregularly, instead of at right angles as they should; the poles are crooked, unpainted, different in size and shape; the cross arms upon them are irregular, and the entire construction is unsightly and improper.

The Board has adopted a few general and easily comprehended rules and regulations for overhead wires, which, if followed, would relieve the overhead service from the danger and unnecessary obstruction which now attend it.

The general principles which have governed the Board in its dealing with the question are the following:

First.—All useless poles and wires must be removed from the streets.

Second.—All dangerous currents must be carried on insulated wires, and the insulation must be maintained.

Third.—All poles must be of a sufficient size to keep the wires away from the sidewalk, sufficient to allow unobstructed operations by firemen.

Fourth.—One line of poles for each class of wires is enough in any street or avenue; and the telephone and telegraph wires must be kept on the opposite side of the street to those devoted to electric lighting.

Fifth.—All the construction of poles and wires should be symmetrical, uniform and safe.

Following these principles, the Board has held that wherever any company received permission to erect a line of poles and construct a line of overhead wires, it must allow its poles to be used by any other company desiring to do so, and offering proper compensation.

The carrying out of this method in all the streets of the city where there are no subways would be of the greatest benefit to the streets, and would enable all electrical companies to operate freely in any part of the city, thereby insuring the best service at the cheapest rate to the public, without the duplication or multiplication of pole lines.

The question of operating electrical conductors in the subways successfully, as has been shown, has been thoroughly demonstrated, and every effort has been made to compel a proper condition of the overhead wires until subways shall be prepared throughout the city.

Final Action of the Board.

Owing to the disregard of the notices sent out by the Board of Electrical Control as to the dangerous condition of the overhead wires, and owing to the constantly increasing dangers from wires which did not conform to the Rules and Regulations, the Board of Electrical Control, on Wednesday, the 9th of October, passed a resolution to the effect that thereafter no more dangerous currents should be operated on improperly insulated wires until such wires had been certified by the expert of the Board to be in good condition.

The resolution passed on Wednesday was served on the companies on the following Thursday; and in spite of it being in the interest of the public for the Board of Electrical Control to give such direction, such badly insulated circuits were in operation on Thursday and Friday.

Nothing could be done to remedy the evils, however, until Dec. 20, when the injunction was vacated by the General Term, and since that time the removal of dangerous poles, wires and fixtures, has been pushed with vigor and determination by the Department of Public Works.

The mistaken course of the electrical companies in refusing to care for their overhead wires, because the time was not far distant when they would be obliged to abandon them for underground wires, has caused suffering and death, and plunged the city of New York into temporary darkness. But the triumph of law is secured at last, and its majesty has been vindicated.

General Recommendations.

The experience in the past shows the necessity in the future for the most rigorous inspection of subways and wires within them, and of such overhead lines as still exist, until such time as subways shall be provided; and it is respectfully recommended that provision be made under which some one department, or official, or board, shall be vested with full power over the whole subject of electricity, and that the responsibility which has heretofore been divided, to the serious detriment of the public interest at times, should be consolidated.

In view of the frequent and constantly increasing dangers from other underground construction in this city than that for electrical conductors, and in view of the fact that a comprehensive system of subways which should include the pipes of the steam, gas, and other companies, as well as the cables for traction and the electrical wires, from which connections could be made to buildings without the removal of the pavements, seems to be required by the exigencies of the situation. It is also suggested that full power to cause the construction of such a comprehensive system of subways or sub-streets might well be vested in some official or official board at this time.

It is further suggested that whenever the Department of Public Works is called upon to remove defective poles and wires, or those provided for underground, the expense of the work of removal shall be borne by the electrical companies owning the defective or unnecessary lines.

The general report was accompanied by that of the Electrical Expert of the Board, Dr. S. S. Wheeler, containing various recommendations and the new rules just adopted by the board. Referring to the condition of the underground electric light lines, Dr. Wheeler says:

"The results of the use of the underground conductors in the subways are very satisfactory. The tests of the conductors used for high tension currents show that there is no deterioration perceptible in the cables by reason of such use as they have been subjected to, in some instances, for six months. Whenever imperfections in the underground circuits have been ascertained as existing, by the tests furnished by the companies, they have proved due to bad workmanship in making joints and connections, or the exposure of the ends of cables to the weather."

Isolated Electric Light Plant of the Manufacturers' Club, Philadelphia.

A model isolated electric light plant is that at the imposing club house of the above named organization, Walnut street, near South Broad, Philadelphia. It is one of the features of the club and the members take pains in exhibiting the plant to the numerous visitors. It was installed about a year ago by the Philadelphia department of the United States Electric Lighting Company under the personal supervision of Manager C. A. Bragg; and in every detail the installation was first class, and the plant has been a success from the start.

It consists of a United States (Weston) shunt-wound machine of 600-lights capacity. The switchboard, with the necessary electrical instruments, is placed in the dynamo room and each floor is controlled by switches situated there. The building is wired in the most thorough manner, and upon test with full load the difference in electrical pressure was found to be only a fractional volt from the binding posts of the machine to the farthest light in the building. On each floor are placed the fuses and general switches.

The dynamo not only supplies current for the lights of the building but for a 5 h. p. motor on the roof for driving an exhaust fan.

The wiring is concealed, and the construction work shows that experienced and skilled electricians did the labor. The combination fixtures and electroliers were furnished by the Thackara Manufacturing Company, of this city; the chandeliers being of German silver, rich in design and embellished with glass ornaments and pendants. The smaller fixtures and electroliers are either of antique brass or ornamental metal, and are of the finest workmanship.

The engine and dynamo room is in the basement; the floor is covered with polished flag and the walls are built of cream colored tile. Everything about this room evinces good taste, the place being clean and bright, and the arrangement of the equipment perfect in every detail. The engine is from the works of the Southwark Foundry and Machine Company, this city, and is known as the Porter-Allen automatic engine. It is of 75 h. p.; cylinder, 10 inches by 20 inches, and makes 240 revolutions per minute. It is a magnificent specimen of an engine, and is specially suited to its elegant surroundings.

Near the engine is a Blake vacuum pump and also a Blake tank pump, both made at the works of the George F. Blake Manufacturing Company, Boston. Between these pumps are two Berryman feed water heaters, each of 75 h. p., manufactured by J. B. Davis & Son, Hartford, Conn. On one side of the room is a nickel-plated Kellam damper and steam regulator, mounted on black walnut; and on the wall directly opposite is a magnificent set of mercury gauges, furnished by Queen & Co., of this city.

In a passageway adjacent to the engine room the walls are occupied by the electrical and mechanical appliances, comprising the Johnson heat regulation apparatus. This meritorious system is not only used to regulate the temperature in every room and hallway in the clubhouse, but, by its thermostatic connections, any ventilator or transom in any room or part of the building can be opened or closed at will.

The boiler room adjoins the engine and dynamo room, and is situated under the Walnut street pavement. It is arched and walled up with glazed brick of a bright buff color and has a floor of polished slate flags. The equipment consists of two horizontal tubular boilers of 50 h. p. each manufactured by Messrs. Charles W. Ervien & Co., of this city; a scale for weighing the coal as the latter passes into a hopper from the coal bin previous to being used; a blow tank for the boilers, a drip tank for the heating apparatus, and a hot water pump and injector for feeding the boilers.

The cost of running this plant is reduced to a minimum; and it is stated that after taking an accurate account of coal by weight, adding the cost of lamp renewals, labor and interest on the plant, the cost does not exceed ¼ cent per lamp hour.

To Secretary Stockton and the Chief Engineer, Mr. Thomas Foley, I am indebted for the foregoing facts.

W. I. B.

Quarterly Meeting of the New England Electric Exchange.

The New England Electric Exchange held its regular quarterly meeting at the rooms of the Boston Electric Club, 7 Park square, last week.

President P. H. Alexander was in the chair. Secretary Henry B. Cram kept the records. The report of the treasurer showed the following financial status:

RECEIPTS.

Cash in treasury October	$329.42
Annual dues	15.00
License fees	110.00
Renewed fees	28.00
Total	$482.42

EXPENSES.

Examinations	$5.00
Stationery, postage, printing, etc	27.12
Telephone	30.00
Clerical work	10.00
Secretary	200.00
Total	$272.12
Balance in the treasury	210.30

The report of the committee on examinations told that out of 343 applicants for examination, 247 had been granted, 13 rejected and there was still 72 to be examined. Fourteen promotions had been made to higher grades.

Chairman Spaulding of that committee suggested that members in the large cities of New England be authorized to examine applicants, thus saving the time and traveling expenses of the committee.

Secretary Cram opposed this, and finally the committee was continued until the April meeting and recommended to devise some means of having the examinations carried on more regularly.

Frank Ridlon, of the committee to secure legislation regarding the removal of dead wires, reported that he had had some little correspondence, but that nothing definite had yet been accomplished. This committee was voted continued.

The committee on instructions made a verbal report.

Following their report, Mr. Ridlon suggested the advisability of getting up a set of rules so simple and comprehensive as to make them valuable to policemen and teamsters in case of danger. He thought every officer of the city ought to know enough about the business to be able to remove a dead wire without being harmed.

He further suggested the advisability of having some means for the education of the gentlemen of the press upon the subject, and hinted that if the writers knew more about electricity there would not be so much that was mere imagination in connection with the tales of accidents from electricity. "More deaths occur from cold water every summer," he said, "than from electricity."

President Alexander gave further statistics showing how small was the number of deaths attributable to electricity.

The committee on instructions was discharged on motion of Secretary Cram.

The committee on membership was voted to be enlarged to seven, the four new members to be chosen from the States not already represented on that committee.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Jan. 20, 1890.

General C. H. Barney, of the Sawyer-Man Co., informs me that things are booming, and it is with difficulty that orders are being filled owing to the great demand for lamps.

Conover & Co. have moved their offices to this city, and are now at 95 Liberty street, where they are better able to meet their customers for engines, boilers, heaters, pumps, pulleys, etc.

Chas. A. Schieren & Co., report having made some large sales recently of large main driving belts for electric light plants. During the week ending Dec. 28 they sold 146½ feet of 60 inch double; 140 feet of 38 and 100 feet of 32.

Visitors in Town this Week have been A. P. Wright, T. McCoubray and T. D. Lockwood, of Boston; Capt. S. Trott and A. H. Hardy Trott, of Halifax, N. S.; H. Igarashi, of Tokio, Japan; Sir John Swinburne, of England.

Mr. R. J. Steen, the newly-appointed New York agent of the Cobb Vulcanite Wire Company, can be interviewed daily at his office, 45 Broadway, where he will be pleased to show the trade the good qualities embraced in the Cobb wire.

W. H. Gordon & Co., 115 Broadway, electric light and power specialities, say that their porcelain pendant cut-outs, Fletcher's sleet-proof pulleys, and single pole incandescent snap switches, are meeting with a extremely good demand, and are being now pushed in this market for the first time.

The Bergen Electric Light Company, of Jersey City, has obtained permission to light the streets and residences in that city, and will begin at once to erect poles, etc. The officers are S. D. Haines, president; C. W. Price, secretary, and L. Walsh, treasurer. The New York office is at 14 Dey street.

Wallace & Sons, 89 Chambers and 71 Reade streets, are pushing their "Little Joker" electro-plating machine, which, as is well known, is specially adapted for nickel, silver and gold plating, and of which large numbers have been sold. These machines run at 1,200 revolutions a minute, and wear well.

Mr. James H. Mason, of 120 Park avenue, Brooklyn, has issued a catalogue which he calls his "January Supplement," and which comprises details as to his improved depolarizing solution for primary batteries, his primary battery lighting plants, his battery zincs, electric night lights, electric motors, decorations, fans, etc.

Bateman & Pollard, 143½ East Twenty-third street, are busily engaged with a number of wiring contracts, installations, etc. They are also sole agents for Bedford dynamo oil. Mr. C. E. Bateman has had a long experience in marine wiring and equipment, as well as in general isolated plants. Mr. H. H. Pollard is an old Edison man.

The John Stephenson Company, Limited, have issued a very handsome illustrated pamphlet on "Motive Power for Street Cars," embodying all the important utterances on the subject at the last street railway convention. Electricity has the place of honor, and on the cover is a neat illumination of the Stephenson overhead trolley car.

The Edison Company in Brooklyn has issued its first report, accompanied by a handsome reprint of Mr. C. J. Field's recent illustrated article on its station in THE ELECTRICAL WORLD The report compliments Mr. Field on his energy and engineering ability, the proof of his capacity being shown in the fact that the plant, on its first four months of operation, got down to a dividend earning basis.

The Walker Electric Company, with $200,000 capital, has been incorporated under the laws of New Jersey, for the manufacture and sale of electric meters and electrical supplies. The officers are: Edwin Scott, president; Geo W. Walker, vice-president and general manager; Lewis G. Tewksbury, secretary and treasurer; principal office 50 Broadway, N. Y. They will manufacture the Walker meter lately illustrated and described in your columns. Since that time it has been remodeled, simplified and generally improved, and brought down to a commercial basis of success. The officers of the company are old and reliable business men, and will give it the necessary backing.

The Magnolia Anti-Friction Metal Company, 74 Cortlandt street, has published a pretty piece of music written for it in Europe, called the "Magnolia Valse," the cover of which has a beautiful chromo-lithograph of the magnolia flower. Any one who desires a copy of this waltz may obtain it by writing to the company and inclosing three cents for postage. The company has also issued a neat illuminated calendar sheet.

Elmer & Amend, Third avenue and Eighteenth street, have just issued a new supplementary catalogue of chemical and physical apparatus, embracing a large variety of instruments specially useful to electricians. They are sole agents for a large variety of imported and domestic appliances. Among these may be mentioned Carl Zeiss' microscopes and Schmidt & Haensch's optical goods. They have a very interesting and serviceable line of batteries, Geissler tubes, laboratory fixtures, magnetos, motors, etc.

Mr. John I. Beggs, vice-president and general manager of the Edison Electric Illuminating Company, 432 Fifth avenue, N. Y., placed Mr. J. Van Vleck, chief electrician, in charge of the reconstruction of the burned station in Pearl street, immediately after the fire. He showed his adaptability for station construction by the quick dispatch, and stability of installation of apparatus. On Jan. 5 everything was topsy turvy; Jan 12, they were running and furnishing current for 9,000 lamps. He planted the new machinery of five No. 32 and four No. 20 dynamos on the main floor, building a foundation of heavy timbers, set in cement and floored on top. A new 200 h. p. N Y. Safety engine, two 180 h. p. standard Safety engines and one 200 h. p. Armington & Sims engines are furnishing power.

Against the Brush Company.—Judge Coxe, of the United States Circuit Court, has filed a decision covering fifteen pages in the important suit of the Brush-Swan Electric Light Company of New England, against the Brush Electric Company. The action was brought to compel the specific performance of contracts between the parties and for an injunction and accounting. The court holds the contracts to have been of such a character that their performance by the defendant cannot be specifically enforced; but the injunction prayed for, restraining the defendant from selling electrical dynamos and apparatus in New England, the territory assigned by the contracts to the complainant, is granted, with a decree for an accounting of the profits. Judge Coxe adds that the injunction should not interfere with any existing contracts made by defendant with third parties, or restrain defendant from furnishing supplies and apparatus for established plants. Joseph H. Choate and William G. Wilson were the solicitors for the complainant, while Albert Stickney and Gilbert H. Crawford appeared for the defendants.

The Elektron Manufacturing Company, 79 and 81 Washington street, Brooklyn, are the manufacturers of Perrel motors and dynamos, which received the highest award at the Paris Exposition, a gold medal. They are automatic in regulation, unexcelled in simplicity, durability and beauty of design, and are said to be the only dynamos and motors with laminated field magnets of softest charcoal iron, by means of which higher efficiency, closer regulation and slower speed are obtained than is otherwise possible They are made in any desired size, and standard sizes are always in stock from ⅛ h. p. up. Incandescent dynamos for electric lighting and isolated plants are given particular attention, to be run with gas engines, water power, etc. They also make moisture-proof dynamos and motors for use in mines and damp places. My attention was arrested the past week by the installation of one of their incandescent dynamos in the National Meter Company's salesrooms, 252 Broadway, where it is to be run from one of the Meter Company's 2 h. p. Nash gas engines, furnishing twenty-five 16 c. p. lamps to light up the salesrooms and offices and to demonstrate the advantages of both machines.

The Zucker & Levett Chemical Company, of 40 Murray street, claim to be the largest makers of nickel anodes, nickel salts, cyanide of potassium, buffing wheels, etc. They cut up over 1,200,000 yards of cotton cloth for buffing wheels last year. Their hexagon buffing wheel is meeting with large sales everywhere. It is made 7 inch, 10½ inch, 12 inch and 14 inch, and is claimed to save from 33 to 50 per cent. The advantages, they say, are: 1. The muslin is of very superior quality, and made expressly for the purpose. 2. The pieces of cloth are so arranged that they form a perfectly circular wheel, and will not ravel out as easily as others, hence will last longer. 3. The polishing rouge or composition will adhere better to this wheel, and not waste and fly over the room, thus saving the rouge as well as the cloth. 4. With this wheel a man can polish much more work in a given time, and with less exertion than with any other buff, because the rouge and buff both stay, and do not fly off. As to their nickel anodes and salts, it is stated that they yield a pure white deposit very closely resembling silver, and only decompose as required in strict proportion to the current applied. The deposit does not crumblen or peel, but is regular and even. The firm have a pretty testimonial from the Edison Phonograph Works as to the apparatus and supplies generally.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Jan. 18, 1890.

Mr. F. E. Alexander has been appointed district engineer of the Boston office of the Westinghouse Electric Company, his appointment taking effect Jan. 1, 1890.

Mr. Fred Whipple, of Detroit, Mich., was in the city this week, and was in consultation with Mayor Hart, regarding the general aspect of electric lighting interests in this city.

The Brookline Gas Company have just ordered for their street lighting a 60-light new Westinghouse alternating arc dynamo, with 50 lamps and converters and transformers. The lamps are of 50 volts and 2,000 c. p.

American Light and Power Company, Auburn, Me., of which Mr. E. W. Gross is the general manager, have ordered through Mr. L. H. Rodgers a 1,000-light Brush alternating dynamo. The lights will be distributed in Auburn and Lewiston.

The Consolidated Electric Manufacturing Company, 149 Congress street, Boston, has acquired the sole right to manufacture and sell the Da is cut-out and contact changer for electric lighting circuits. It has already been illustrated and described.

Mr. G. G. Coleman, of the Thomson-Houston Electric Company, has left for Oswego, N. Y., to superintend the installation of a large electric light plant in that city. There will be for the present about 200 arc lights, with dynamos, and two 1,350-light alternating incandescent machines.

The Standard Electric Company of Vermont have sold, through Mr. A. E. Rich, 288 Pearl street, New York, their New York agent, a 200-light plant for the steamer "Newburg," of the Homer Ramsdell line of Hudson River steamers. A Payne engine will be installed to furnish the power.

The Boston Electric Club held its first monthly business meeting under the new administration, and Mr. Cram made an interesting speech, outlining his views as to the method of conducting the club. The House and Entertainment Committeee submitted a very interesting programme for the coming year.

Malden, Mass.—The Malden Electric Light Company has declared the usual quarterly dividend of two per cent., payable Jan. 15, 1890. The company lights Malden, Melrose, Medford and Everett, 25 square miles of territory, and it has now the equivalent of 500 arc lights in use, as compared with 85 two years ago.

Tests of Safety Fuses.—An opportunity is afforded to all to submit any device of the character of a safety fuse for electric wires to the Board of Fire Underwriters at 55 Kilby street, Boston. A careful and thorough test will be made of all samples submitted, and the best device will probably be adopted by the electric companies.

Worcester, Mass.—The Worcester Electric Light Company has re-elected directors as follows: T. M. Rogers, Stephen Salisbury, A. B. R. Sprague, S. E. Hildreth, T. C. Bates, Josiah Pickett, Samuel Winslow, Loring Coes, N. S. Liscomb, W. A. Denholm, Alzirus Brown. The board organized with T. M. Rogers president and H. H. Fairbanks clerk and treasurer.

Lowell, Mass.—The Eastern Electric Light and Storage Battery Company, of this city, has shipped a complete lighting plant, including dynamo and storage batteries (Sorley patent), to a firm at Leicester, Eng. Several factories and the Appleton National Bank have been equipped by this company with storage battery plants, and they are reported to be quite successful.

Mr. H. M. Doubleday and Mr. T. Spencer, of the Marr Construction Company of Pittsburgh, are both in the city at present, and are busy looking into the necessities for providing a home for the new Westinghouse system for the Suburban Electric Light and Power Company, which recently got the contract for the city lighting. Mr. Spencer has but recently returned from London, where he superintended the installation of a Westinghouse plant in that city.

Mr. B. F. Porter, of Danversport, who for some two years past had been bookkeeper and cashier for the Boston office of the Westinghouse Electric Company and Sawyer-Man Company, died early this week. He was attacked by the prevailing influenza, which led to heart failure and general prostration. Mr. Porter, though of a somewhat retiring disposition, was a most valued official of the company, and his kind ways had won for him hosts of friends among electric men far and near. A resolution of respect to his memory was adopted by his fellow employés and a copy sent to his family.

Playing with Electricity.—In a factory in Hartford, Conn., a number of boys have been in the habit of leaning out of a window and touching an electric light wire for the purpose of receiving slight shocks. This week one of the boys was engaged in this favorite sport, and, the day being wet, the insulation of the line was necessarily reduced, and he received sufficient of a shock from a 1,000-volt current to kill him in ten minutes. In a few more years it is to be hoped that the general public will be sufficiently enlightened to understand that it is just as safe to play with electric light wires, which are harmless enough if left alone, as it is for the proverbial monkey to play with the buzz-saw.

Reduction in Price of Edison Electric Light.—The Edison Electric Illuminating Company of Boston have issued the following notice to consumers: "Beginning with Feb. 1, 1889, the regular commercial price of the Edison incandescent light, as furnished by this company, will be reduced to one cent per hour for 16 c. p. lamps; all other candle power will be reduced in the same proportion." This is a step in the right direction, and the Edison Illuminating Company expect a large increase of lights. They have now something like 25,000 lights in service, and have recently introduced a number of the Kinsman arc lamps to be used two in series in their regular 110-volt circuits. They have at present about 20 in use, and have quite a demand for them, and will in the near future make a feature of this kind of lighting.

West End Street Railway.—There seems little doubt but that Boston will have an overhead electric railway in the more crowded streets of the city before a great length of time. The plans of the system are all made, though not open to general inspection, and they are reported to represent a structure which will be a great improvement over any of the existing overhead railways, being light and airy in design, substantial, and as architecturally beautiful as it is possible for such a structure to be. The application to the Legislature for a charter will be made, and no doubt is entertained but that it will go through all right, though there will necessarily be rival companies in the field. The West End Street Railway Company have recently adopted the system of putting gates on the platforms of the electric cars to prevent people getting off on the side next the adjacent track. The gates are detachable and at the end of each trip are changed from the one side of the car to the other.

Lowell, Mass.—The Lowell Electric Light Company will make an extensive rearrangement of their plant now located on Middle street. By reason of their contract with the Lowell and Dracut Street Railroad Company to furnish power for moving street cars, the Electric Light Company is obliged to seek larger quarters. A lot of land 160x300 on Pleasant street has been purchased of the Rogers Land Syndicate, as the owners are locally known, and they will erect thereon a brick building. Their plant will be arranged by the Thomson-Houston Electric Company. Work will be begun immediately. The location is near the Lowell and Andover section of the Boston & Maine railroad, which is convenient for the reception of coal. It is favorably situated for the distribution of light and power. The company's plant consists of two alternating dynamos of 2,300 h. p. used for the street cars. By contract with the city and merchants 530 arc lights are furnished and 600 incandescent. The company's steam plant, now of 1,000 h. p., will be increased to 5,000 h. p. The company, originally the Middlesex Electric Light Company, organized under the laws of the State of Maine, absorbed the Lowell Electric Light Company, and about a year ago reorganized under the laws of Massachusetts with the last mentioned title. W. A. Ingham is president.

The Board of Aldermen had quite an electrical session at their last regular meeting. The subject of an electric light plant for the city was referred to the Committee on Lamps. A communication, signed by 135 business men, firms and property holders, protesting against the duplication of wires, considered necessary for the new electric light company, was referred to the Committee on Electric Wires; a similar communication from 28 underwriters in Boston was received and also referred to the same committee. A communication from the mayor was received calling attention to the fact that his recommendations to the city council in regard to the regulation of telegraph, telephone and other electric wires have not produced any legislation, and concluding with the recommendation that a superintendent of wires and electrical appliances is necessary, to have control all over the city, subject to such orders as the mayor and aldermen may lawfully issue. The following

order, offered by Alderman Reed, was passed: Ordered, That a joint special committee, consisting of five members of the board of aldermen with such as the common council may join, be appointed to consider the subject of superintendence of electric wires in the city of Boston. Finally, a petition from the Suburban Electric Light and Power Company was received for permission to erect and use eight stationary engines of 1,000 aggregate horse power, and a petition was received from the Walworth Light and Power Company for permission to lay or erect wires over or under the streets of Boston.

Boston's Electric Street Lights.—Since the announcement of the mayor of his award of the contract to furnish the city of Boston with electric lights to the Suburban Light and Power Company, there has been a great deal of conjecture as to what this company's policy would be. There has also been a great deal of discussion as to the validity of the charter under which this company proposes to act, and not a little newspaper correspondence and petitioning to the mayor, to prevent any duplication of the overhead wires in Boston. A good deal of bitter feeling has been engendered over the action of the mayor in setting a maximum price of 40 cents, and considerable sympathy has been expressed with the Boston Electric Company, who have a plant valued at $1,500,000, and who have given Boston as good a light as there is in any American city. However that may be, the fact remains that the Suburban Company have definitely got the contract, and the Westinghouse Electric Company have received orders from them for the necessary plant. The Suburban Company has a paid-in capital of $75,000, and it will probably increase it to $250,000 at once. The directors of the company are: C. H. Clapp, president; A. C. Burrage, secretary and treasurer, as well as counsel; Hon. A. W. Tufts, W. A. Paine and Frank Ferdinand, all well known business men of Boston and residents of Roxbury. The Westinghouse Electric Company have orders for twelve 60-light alternating arc dynamos, with lamps, transformers and everything complete. The station will be on Swett street. In this contract will be used the new Westinghouse alternating arc system, which has never yet been described, and which is not yet very well known to the majority of electric light men. The arc lights will be alternating, and will have flat carbons, each of which will last for *forty hours*. In the city the high-tension wires will be underground, as also the converters, so that only the secondary wires of 50-volt pressure will come above the surface and enter the lamp post. The cables, which will be of very specially high insulation, will be carried in conduits of sheet iron lined with cement, and provision is being made for two such conduits of ten holes each for the trunk lines. Electrical engineers will watch the progress of the work with the utmost interest, as it can be confidently said that this is an entirely new departure in the methods of arc lighting. The engineers of the North American Construction Company, of Pittsburgh, are here at present, laying out the work, which will probably be under the supervision of Mr. T. Spencer, a gentleman of long and varied experience in the electrical field. Mr. George Westinghouse, Jr., was in Boston this week, and aided in the consummation of the contract.

A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, Jan. 18, 1890.

Personal.—Colonel Diogenes Chalmers, the genial representative of the Empire City Electric Company, of New York, was in this city during the past week.

Removal.—H. T. Paiste, manufacturer of the Paiste switches, cut-outs, etc., has removed from No. 1,206 Chestnut street to more commodious quarters, corner Twelfth and Market streets, this city.

The Schuylkill Electric Railway Company has been incorporated at Schuylkill, Pa., with the following officers for the ensuing year: B. S. Patterson, president; John F. Ferby, secretary and treasurer.

Lovegrove & Co., established in this city in 1870, manufacturers and dealers in engines, boilers, machine tools, etc., etc., have filled several orders recently for their electric automatic water gauges, and in machine tools alone are enjoying a lucrative trade among the electrical manufacturing companies of Pennsylvania, New Jersey, Maryland and Deleware.

Partrick & Carter, of this city, report their business as highly satisfactory in every department, and the outlook for the year as very encouraging. They received on Dec. 10 a patent on their "P. & C." needle annunciator, and it is now ready for the market. The improvements are such as will make this annunciator more popular in the future than ever in the past.

W. S. Griffith & Co., engineers and contractors, this city, have their men at work wiring the new residence of Mr. William Mann. This firm has received the contract to instal and equip a large isolated plant at the mammoth millinery house of I. S. Custer's Son, on Eighth street. Both the arc and incandescent systems of the Mather Electric Company will be used.

Personal.—Mr. C. D. Warner, of New Haven, Conn., was in this city for a few hours last Monday, and favored this office with a visit. Mr. Warner is one of the best known electrical inventors in New England. To his inventive genuis are due the following: Warner's electric light gauge, Warner's electric battery gauge and the reliable electric time system introduced in various sections of New England and the West by the Standard Electric Time Company, of New Haven.

Horn, Brannen & Forsyth Company, of this city, report business fairly active considering that this is the dull season of the year in the fixture line. The company are very much encouraged to note the steadily increasing demand for combination gas and electric light fixtures from all sections of the country. They are making for the Albany & New York night line of steamers "Drew" and "Dean Richmond" a large number of incandescent electric light chandeliers and brackets of special and elaborate design in polished brass. It is interesting to note that the electric light will be the only illuminant hereafter used on the steamers named. The United States Electric Company's system of incandescent electric lighting will be used.

The Local Edison Company.—At the annual meeting of the Edison Electric Light Company, held yesterday, a report was presented showing the monthly expenses to have been about $8,000 and the income $20,000, leaving a monthly profit of about $12,000. The debt is about $100,000. These directors were elected: Samuel B. Huey, D. S. Lindsay, John Lucas, L. D. Brown, Arthur Colburn, B. K. Jamison, Amos R. Little, Charles M. Swain, H. Blake Tyler, William T. Tiers, Joseph P. Ord. The officers of the corporation were elected as follows: President, L. D. Brown; vice-president, B. K. Jamison; secretary and treasurer, A. V. Sloan; solicitor, Samuel B. Huey; supervising engineer and general manager, William D. Marks.

Electric Car Experiments.—The people's Passenger Railway Company has been making a number of experiments with electricity with the idea of substituting, if practicable, that power for horses. An experimental trip was made on Saturday, Jan. 11, with a car that had been fitted up with 92 cells of the new storage battery invented by Mr. J. F. McLaughlin, of this city. The car started from the depot at Eighth and Dauphin streets, and without mishap made the trip southward and started on its return journey. Again on Wednesday, Jan. 16, the same car, with a large party on board, made a trip over various branches of the People's Railway to Wayne Junction and return. The entire trip was made without a hitch, slip or mishap, and every one of the party was highly gratified.

A Novel Conduit was patented recently by Mr. James Tatham, of Philadelphia, and it promises to completely revolutionize the wire conduits at present in vogue. The construction of this new conduit in brief, consists of an iron pipe, having inside a thin lead pipe, covered with a textile saturated with an insulating compound. A hydraulic expander being placed within, the lead pipe is then expanded and the insulating material is forced in intimate union with the iron and lead. The lead is, however, practically insulated from the iron, and a cable or any number of cables, simply saturated in an insulating compound, may be drawn through the conduit without previously having the customary lead encasing. This process may be applied to any size of pipe. An ingenious device is provided for making the proper joints and carrying out the branches.

Electric Railway for Lancaster, Pa.—Advices under date of Jan. 13 from Lancaster, Pa., read as follows: At a meeting held to-night by the stockholders of the Lancaster and East End Street Railway Company, it was resolved by unanimous votes to sell those lines to a company that will operate them by electric motor. The stock is to be taken up at its par value, $50 per share. The new company will assume immediate possession, and will have the lines running by electricity within three months. Both lines merge under the name of the Lancaster Electric Street Railway Company. The following officers were elected by the new company: President, John A. Coyle; secretary, J. E. Ackley; treasurer, John H. Baumgardner; solicitor, Walter M. Franklin. Board of Directors, including the officers named, Dr. M. L. Herr, Jacob B. Long and Sumner T. Dunham.

De Kosenko & Hetherington, the designers and manufacturers of combination gas and electric light fixtures and electroliers, this city, have furnished the Duquesne Club's new building at Pittsburgh, Pa., with combination fixtures of special choice design in real bronze, old brass and wrought iron. So well pleased are the Duquesne Club people with the painstaking and artistic work done by the firm that they have expressed their thanks and appreciation in the form of a strong testimonial. Messrs. De Kosenko & Hetherington have also furnished combination fixtures for the seven-story granite building of the Fidelity Title and Trust Company, Pittsburgh, and the new station of the Baltimore & Ohio Railroad in the same city, and also for the Allegheny City High School. Most of the orders last mentioned are wrought iron fixtures of special design and beautiful workmanship. W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Jan. 18, 1890.

Union City, Mich., wants an electric light plant.

South Bend, Ind., will have an electric railway of the Thomson-Houston system.

Mr. Ernest Hoefer, Chicago, reports the sale of about 100 miles of heavy copper wire.

The Conant Furniture Company, Toledo, have recently had a 100-light Edison plant installed.

Mr. P. C. Ackerman, of the American Electrical Works, is smiling with his Western friends this week.

Mr. W. H. Wheeler, of the Eclipse Wind Engine Company, Beloit, Wis., has been stopping in Detroit for several days.

Marshall, Mich., is examining the various electric lighting methods, with a view to putting in a plant at an early day.

Mr. E. M. Baird, of the Eddy Electric Manufacturing Company, Windsor, Conn., has been visiting Chicago friends during the week.

The New Orleans, La., Edison Illuminating Company will add two large dynamos and an additional engine to its plant during the month.

Mr. Gilbert M. Smith, manager of the Chicago office of the Ansonia Brass and Copper Company, dined at the Cadillac, Detroit, on Thursday last.

Mr. Andrew C. Daniel, of the Consolidated Coal Company, of St. Louis, has purchased a controlling interest in the Danville, Ill., Gas Light Company.

Mr. O. M. Hubbard, of the Cincinnati Edison Illuminating Company, has secured the agency for the Charles D. Jenney & Co.'s motors in Cincinnati.

The Goodrich Hard Rubber Company, Akron, O., are making a special rubber bushing of medium hardness for use on the Morris insulated hangers.

The Calumet Electric Lighting Company has a proposition in the hands of Comptroller Onahan for lighting the streets of South Chicago at $84 per lamp.

The Bay City (Mich.) Common Council, Monday night, refused to grant a franchise to the West Bay City Electric Railway to lay tracks and operate cars in Bay City.

The James Leffel Company, of Springfield, O., has been duly incorporated under the State laws of Ohio, with a capital stock of $250,000, to continue the manufacture of turbines, etc.

J. C. Emory, the electric belt swindler, of Cincinnati, was sentenced to the Ohio Penitentiary for fifteen months and fined $500 and costs by Judge Sage, of the United States Court.

The Fisher Electric Company, Detroit, have installed a 200-light Fisher incandescent dynamo in the Copper and Brass Rolling Mills, and a 100-light plant in the new Seeley building.

Detroit, Mich., is involved in legal difficulties over the awarding of the new city lighting contract to the Detroit Electric Light Company. The old Brush Company has obtained an injunction.

Mr. Edward D. Swasey, a well-known business man, formerly of Covington, has secured the local agency in Cincinnati of the Cincinnati Electric Engine Company's constant current motor.

Mr. J. C. Hobart, Secretary of the Triumph Compound Engine Company, Cincinnati, expects to be present at the Convention, and will endeavor to have one of his engines in operation there.

The Lunkenheimer Brass Manufacturing Company, Cincinnati, are making a sight-feed oil cup of especial merit for use with dynamo electric machinery, and are supplying the same to all the large companies.

Mr. George Cutter, Chicago, during the month of December, sold over 7,600 of his new combination tin shade for incandescent lamps, and over 3,000 hoods for protecting incandescent lamps where used in street lighting.

Cincinnati's City Inspector.—The City Council on last Monday considered an ordinance to appoint an "Electrical Inspector" at $2,500 per year and pay the University $1,000 per year for the use of its apparatus. The ordinance was engrossed.

The Chicago Telephone Company has sent to the comptroller a check for $10,761.63, being three per cent. of the earnings of the company for the six months ending Dec. 31, 1889, as provided by the telephone franchise granted by the council a year ago.

The Lake View Electric Light Company have secured a permit to erect electric light wires on poles in Lake View (Chicago) on Diversey avenue, from Lincoln avenue around to Clark street, and on Halsted street, from Fullerton avenue to Belmont avenue.

Mr. William Oswald, of New Orleans, has installed the following Sprague motors during the last month: Three 5 h. p., one 7½ h. p., one 10 h. p., one 20 h. p., one 15 h. p., two 2 h. p., and one 1 h. p. motors, which speaks well for the motor business in the south.

Western Union Telegraph Company Sued.—Joseph E. Carle, a well-known citizen and oil man of Petroleum, Pa., has brought suit against the Western Union Telegraph Company for $10,000 damages alleged to have been caused by the non-delivery of a message.

The Cyclone Fan Company, of Streator, Ill., has been incorporated, with a capital of $100,000. C. H. Rathburn, John Kangley and S. L. Graves are the organizers. It is a very promising venture, the fan being an exceptionally good one for the ventilation of mines.

The Consolidated Street Railway Company, Toledo, are about to place a Daft motor car on their line, to be operated by current supplied from 92 Gibson storage cells of 150 ampère hours capacity. The track is about 2½ miles in length, fairly level, but has two sharp curves.

Mr. George B. Kerper, President of the Mount Adams & Eden Inclined R. R. Co., Cincinnati, and one of the best known street railway men in the country, has been elected president of the Queen City Electric Company, of Cincinnati, in place of Mr. Lamont, who resigned on account of ill health.

East Saginaw, Mich.—The Saginaw Union Street Railway gave an official test of the electric motor on the 6th inst. Two of their finest cars, with city officials of both the Saginaws and several members of the Detroit Electrical Works on board, ran over their line. It was pronounced a perfect success.

A Proposed Electric Railway.—Arrangements are being made to run an electric road from Covington to Ludlow, Ky. The company is to be composed of Messrs. D. C. Collins, F. P. Helm, John Ernst, R. H. Fleming and J. W. Clark. It is believed that the road will be a paying one in the course of a year.

Mr. Paul Chaney, manager of the supply department of the Central Thomson-Houston Electric Company, of Cincinnati, has recently sold over 300 miles of K. K. weatherproof wire and several hundred thousand feet of Grimshaw white core wire. He has secured the agency of the Grimshaw goods for the central States.

Mr J. W. Godfrey, general manager of the New York Insulated Wire Company, dined at the Gibson House, Cincinnati, on Thursday, with Mr. H. P. Lucas, of the Holmes, Booth & Haydens Company, and endeavored to make Lucas believe that Grimshaw would ordinarily test 170 megohms after lying in water for thirty days.

The Swift Electric Light Company, of East Saginaw, Mich., recently ordered new engines and machinery from Milwaukee. Tuesday, while being unloaded from the cars, half a flywheel weighing six tons fell from the derrick and was broken in pieces, causing a loss of $1,000 and a delay of several weeks in operating the works.

The Markle Engineering Company, Detroit, are wiring the enlarged buildings of the Northern Asylum for the Insane at Traverse City, Mich. The treasurer of the asylum, in a late report, stated that owing to the economical operation and efficiency of their Edison plant the gross lighting expenses had been considerably decreased, while a far better light had been secured.

Mr. E. E. Hartman, of Minneapolis, was tendered a reception by the employés of the Leonard & Izard Company, on the evening of his departure for Chicago, and was presented with a fine set of electrical instruments. With speeches from Mr. W. F. Smith and from Mr. Stuckey, aided by music and an excellent collation, the evening was pleasantly passed.

Michigan State Association.—An important meeting of the representatives of the electric light and power industries of the State of Michigan will be held in the office of the Brush Electric Light Company, Detroit, on the 17th for the purpose of organizing a State association. A majority of all the companies now in business have promised to be represented and to further the object sought, and Mr. Lockwood deems success assured.

St. Louis, Mo.—On Sunday, 12th inst., just after the Bell Telephone Company of Missouri had restored their lines prostrated by a sleet storm, a cyclone swept across St. Louis, tearing away roofs, stacks, walls and chimneys, the debris falling on the wires. On Monday morning the company had 656 wires in trouble. With the aid of calcium lights, the company's linemen were enabled to work at night, and thus succeded in a second complete restoration in 48 hours.

Electric Light Men Strike.—Eighteen of the employés of the East End Electric Light Company at Pittsburgh announced their intention on Jan. 10 of doing no work for a company that had been declared by the American Federation of Labor to be non-union, and joined the strike against the Allegheny County Electric Light Company. The places of the East End strikers were filled shortly after they quit. The company announce that all lights will burn as usual.

The Cincinnati City Council has passed a resolution to appoint a joint committee of five from each board of Council to act with the Board of Public Affairs and the city solicitor in making a thorough investigation of underground conduit systems for electric wires. Mr. Robert S. Finch, assistant to Prof. French, Cincinnati's city electrician, has resigned his position in order to devote all his time to his studies. His salary was $600 and Prof. French's is $1,200 per year.

A Prospective Treat for the Delegates.—There is every probability that the members of the electrical fraternity who gather in Chicago on Feb. 10, while en route to the National Convention, will be treated to a ride on a train consisting of a special motor car and two trail cars now being equipped in the factory of the Woodward Electrical Company, Detroit, to make the trip to Chicago over the line of the Michigan Central Railway, that company having kindly offered the free use of its tracks, the loan of a pilot engine to precede the train and a conductor and necessary brakemen. The motors will be of special design, each having *two armatures* revolving within the fields, full details of which are not

for publication at the present time. The necessary current will be supplied by a set of Detroit storage cells, that, if necessary, can be recharged at Kalamazoo. A jolly party of railway officials, electricians and journalists will be invited to make the trip, which, if successful, will be the most remarkable on record. If the use of the tracks can be secured it is the intention to also take the train through to Kansas City, arriving there before the association adjourns.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 68@ $69
Central Union	58@ 59	Wisconsin	114@ 115
Michigan	98@ 100	Bell of Missouri	150@ 151
Great Southern	31@ 32	Iowa Union	23@ 25
Colorado	35@ 38	Missouri and Kansas	57@ 58
Rocky Mountain Bell	40@ 41		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$73@$76	Chicago Edison Co	$98@$108

F. De L.

THE TELEGRAPH.

Fresno, Cal., is to have a fire-alarm system put in by J. M. Klein & Co., of San Francisco.

Oregon.—The Willamette & Calapoosia Railroad Company propose constructing a telegraph line.

T. M. B. A.—Assessment No. 237 has been made for January for $1, to meet the death claims of M. J. Mangan and J. H. Honea.

Grant, Ore.—The Sherman County Telegraph and Telephone Company has been formed by M. Mackenzie, W. Grant and V. C. Brock, with a capital stock of $1,000.

The Southern Oregon Telegraph and Telephone Company has been formed by J. A. Brown, J. T. Flynn and J. W. Hayes, at Grant's Pass, with a capital stock of $10,000.

Brunswick, Ga.—The South Brunswick Telegraph, Telephone, Electric Light and Water Company has been incorporated by J. F. Degnon, W. E. Tench and A J. Crovatt, to construct and operate telegraph and telephone lines, an electric light plant, etc. The capital stock is $50,000.

The Commercial Telegram Company formally went out of business last week, but will soon be in good shape again under the control of Mr. John A. Mackay; or, rather, of the New York Stock Quotation Company, to which the plant will be leased. The old Commercial Company has had a lively time of it since its foundation in 1882. The Stock Exchange now will control it.

A Telegraph Land Subsidy.—An English company called the Newfoundland Colonization and Mining Company has acquired 64,000 acres of land in Newfoundland, which were granted to the Anglo-American Telegraph Company in 1854. Some of the grants contain coalbeds and various minerals, and others are adapted for agriculture and lumbering. The company has been organized by a number of prominent men, who expect to be able to attract a large stream of immigration to the colony.

THE TELEPHONE.

Japan.—The Mikado of Japan has had constructed a telephone line between Yokohama and Striznoka, a distance of about 100 miles. It is the first telephone applied to the public service in Japan, and has, so far, been completely successful.

The National Telephone Company, Ltd., of England, have sent us a list of their exchanges, etc., up to October, 1889, showing 25 exchanges, 475 call offices, 21,011 exchange lines and 4,702 private lines. These are in the North of England, Scotland and Ireland.

THE ELECTRIC LIGHT.

Shelby, N. C., will let a contract for town electric lighting.

Weston, W. Va.—Stern & Silverman, of Pittsburgh, have secured the street lighting contract.

Memphis, Tenn.—The East End Railway Company expects to put in an arc and incandescent plant.

Kissimmee, Fla.—Andrews & Towne wish to enter into correspondence with arc light manufacturers.

Paris, Ky.—Mr. J. M. Thomas and others in a stock company are beginning work on an electric light plant.

Wheeling, W. Va.—The Schmulbach Brewing Company will put an electric light plant in its new brewery.

Barnesville, W. Va.—The Barnesville Gas and Electric Light Company has been formed with a capital stock of $40,000.

Louisville, Ky.—The Dupont Paper Mill Company is in the market for an incandescent plant not exceeding 100 lights.

St. Joseph, Mo.—The Globe Electric Light and Power Company are increasing their capital stock from $25,000 to $250,000.

Barnesville, Ga.—The Barnesville Manufacturing Company will put in an electric light plant and automatic fire extinguishers.

Asheville, N. C., a growing city of which C. D. Blanton is mayor, intends to let a lighting contract or to buy a plant of its own.

Alliance, O.—The Mutual Electric Light Company and the Alliance street railway have secured the contract for street lighting.

Petaluma, Cal.—The Petaluma Electric Light Company has been formed by G. B. Coddington, W. S. Pierce, J. H. Beggs and S. H. Taylor, with a capital stock of $10,000.

Wilkinsburg, Pa.—The Wilkinsburg Electric Light Company has been formed by J. A. Watson, W. M. Brinker, G. W. Egge and J. H. Harlow, with a capital stock of $30,000.

Weeping Water, Neb.—The Weeping Water Electric Light Company has been formed by J. P. Smith, H. Ashmum, J. Chase, A. M. Miller and others, with a capital stock of $30,000.

Redwood City, Cal.—Mr. O. R. Brandt has secured a contract to light the town. He has bought the Ball plant of the Milling Company, and will put in a 500-light incandescent machine.

The Mobile (Ala.) Land and Construction Company, which has been formed by R. Gage, J. H. Turner and others, of St. Louis, intends, among other things, to put in an electric light plant.

Dubuque, Ia.—The United States Electric Light and Power Company are about to install an Edison central station, and announce that they are in the market for from 15 to 25 tons of bare copper wire.

Snow Hill, Md.—The Snow Hill Electric Light and Power Company has capitalized at $12,000, and is using the Edison three-wire system. Mr. J. P. Moore is president and Mr. W. S. Wilson secretary and treasurer.

The New Brighton Electric Light Company has been formed at East St. Louis, Ill., with a capital stock of $20,000. P. W. Abt is president, M. Benzen vice-president, and T. L. Fekete secretary and treasurer.

The Central Electric Company has, it is stated, been formed by C. F. Fargo, J. Redding, L. L. Baker, G. P. Adams and C. H. Wilson, with a capital stock of $250,000, to build and operate electric plants on the Pacific Slope.

Name and Portrait, Please.—The *Portland-Oregonian* is responsible for the statement that a servant girl there, who has become accustomed to the advantages of electric lighting, recently refused another situation because the house was without incandescent lamps.

Piedmont, Ala.—The Piedmont Land and Improvement Company has been formed to build a new industrial town, and it will require an electric light plant. Mr. Preston Lea, of Wilmington, Del., is president; Mr. W. G. Ledbetter, of Anniston, vice-president, and Mr. R. D. Conso, of Anniston, secretary and treasurer.

Fresno, Cal.—At the annual meeting of the Fresno Gas and Electric Light Company the following were elected: President, L. Leach; vice-president, F. G. Berry; secretary, F. C. White; superintendent, D. Decker; assistant superintendent, S. E. Johnson; directors, L. Leach, F. G. Berry, P. P. Dryler, W. W. Phillips and C. M. Berry.

Jersey City, N. J.—The Bergen Electric Light, Heat and Power Company have already started operations since securing their city contract, and already have 400 subscribers for lights, beginning in the hill section. Prices will compete with those of gas. All the capital has been subscribed, the plant is being got ready and the pole lines are going up.

Westinghouse Plants.—Among the contracts for central station alternating current apparatus already reported by the agents of the Westinghouse Electric Company for the month of January are the following: For Red Oak, Iowa, 750 lights; Allentown, Pa., 1,500; Elmira, N. Y., 750; Jacksonville, Ill., 750; Maryville, Mo., 750. All of these orders are for new plants, except in the case of Elmira, which is an increase. The original plant was installed there during the latter part of the year 1889.

Brush Double-Carbon Lamp Patent.—Judge Gresham has handed down his order confirming his recent decision in favor of Mr. C. F. Brush as to priority of invention in double-carbon lamps. The case is referred to W. P. Fishback, a Master in Chancery of the United States Circuit Court at Indianapolis, for a full accounting as to the damages sustained by the plaintiff Brush Electric Company, and the defendants, Fort Wayne Company et al, are placed under a perpetual injunction. It is further ordered that the defendants pay the costs as taxed.

Westinghouse Alternating Arc System.—Since the numerous tests and experiments with the new arc light system of the Westinghouse Electric Company have proved successful, the company has decided to extend the arc light business as much as possible. The works in Pittsburgh are now being enlarged, and all the detail work is now removed either to Newark or New York to give more space to arc light work. The new six-story building which is taking the place of the structure which burned down several months ago is to be exclusively utilized for the manufacture of arc lamps. The socket department was last week removed to Newark to make needed room in the Pittsburgh works.

Electric Lights in London.—The London *Daily Telegraph* recorded a short time ago the proceedings at the annual meeting of the Metropolitan Electric Supply Company, of London, England. The corporation has contracted with the Westinghouse Electric Company for central station plants of 50,000 lights capacity, and the first instaliment of 15,000 lights has been in operation for several months. The central station is situated in Lincoln Inn Fields. Several of the most famous London edifices are lighted from this plant, among others Drury Lane Theatre, the Gaiety Theatre, Exeter Hall, Terry's Theatre, the Royal College of Surgeons, the Government Record Office and the Holborn restaurant. At this meeting, Sir John Pender, the president of the company, spoke in high terms of the Westinghouse alternating current system, stating that from the day the plant had commenced operations there had never been the least interruption in the system. He emphasized the fact that the company had performed everything which had been promised at the time the contract was made.

APPLICATIONS OF POWER.

Anniston, Ala.—The Anniston Street Railway Company will adopt electricity as motive power.

Oakland, Cal.—J. W. Coleman, G. W. McNear, W. D. English and others, have asked for a franchise for their proposed electric road.

Minneapolis.—The Minneapolis street-car lines will not be equipped with the cable system after all, although cable plant to the value of $400,000 has already been bought. The company has adopted electricity, and the cable apparatus is to be sold for old iron. About 110 miles of electric line will be built. St. Paul follows suit.

PERSONALS.

Mr. T. A. Edison knows now that la grippe is no respecter of persons.

Mr. C. E. Bateman, of Buehler & Bateman, of 143½ East Twenty-third street, write to us to say that the electrical wiring at the New York Hospital was done by them and not by Hatzel & Buehler, as stated.

Werner Von Siemens, in a recent interview in Berlin, said: "We are not afraid of electric currents here. To us electricity is an obedient slave and not the fiery demon which your New York papers seem to represent it."

Mr. Charles Lever.—A cable dispatch from England announces the death of Mr. Charles Lever, the electrician, and the message presumably refers to a gentleman well known on this side of the Atlantic, both by his inventions and his visits to this country.

Paul D. Dyer, who died at Santa Fe, New Mexico, on the 5th inst., was known to a large number of workers in the electric light field. His first work was upon the first central station plant of the Edison Electric Light Company, in New York City, in 1881. From that time to the time of his death he was connected with the Edison electric light interests, first with the Edison Tube Works later with the installation of isolated plants, and, when Mr. Edison formed the first central station construction company in 1883, he undertook the making of original surveys for that company, which work reached a high degree of perfection in his hands. He also installed, as engineer, several station plants for Mr. Edison, and gave promise of large success as an electric light engineer. His health failed, however, and he was compelled to go to Colorado in the winter of 1886-7, where he acted as agent for the Edison Company. He was only 29 years old at the time of his death.

MISCELLANEOUS NOTES.

New York City.—Commissioner Gilroy of the Board of Public Works has been conferring with the Board of Electrical Control and the officers of the companies interested, as to the further removal of telegraph and telephone wires and poles.

J. F. Davison & Co., Equitable Building, this city, have issued a small book, price $1, entitled "Inventors' Manual," giving pointers as to "how to work a patent to make it pay." It is stated that the work is written by an experienced and successful inventor. A variety of interesting information is given, as well as a number of forms, and it closes with an appendix giving the counties of over 10,000 population, as compiled from the census of 1880.

Montreal, Can.—W. Van Slooten and E. H. Potter, New York; Wm. B. Turner, of Boston J. Odilon Dupuis and J. Cochrane, of Montreal, will apply to the Legislature to incorporate a company under the name of "The Montreal Underground Conduit Company," with the object of providing the necessary means to put under ground telegraph, telephone and all other electric wires or cables, with exclusive power to construct, establish and maintain during forty years, subterranean conduits in the streets of the city of Montreal and other municipalities in the district, with the right to exact rent for the use of the said conduits. The capital is fixed at $100,000.

Acquisitions by Mr. Edison.—A magnificent piece of statuary, representing "The Genius of Light," was received from Paris by Mr. Thomas A. Edison a few days ago. It now stands upon a pedestal in the centre of the library in Mr. Edison's laboratory at Llewellyn Park, Orange. The statue is about eight feet high and is of pure white marble. It was exhibited at the Paris Exposition, where it was seen by Mr. Edison, who admired it very much, and seeking out the owner purchased it on the spot. The statue represents an angel bearing aloft in her right hand an incandescent electric light. Mr. Edison has also bought the Kunz collection of 3,500 minerals and gems, shown at Paris by Tiffany & Co. This latter purchase is intended to facilitate some of his work.

BUSINESS NOTICES.

The Electrical Supply Company of Chicago has issued circular No. 594, which is a list of special goods owned or controlled by it or largely manufactured by it or for the handling of which it has made special arrangements.

The Phosphor-Bronze Smelting Company, Limited, 512 Arch street, Philadelphia, have issued a new price list of their roll and sheet metal, telephone wire, etc., which will be forwarded to any address upon application.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidently grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

Messrs. James Leffel & Co., Springfield, O., manufacturers of the celebrated "Old Reliable" water wheel, and superior steam engines and boilers, have enjoyed a very fine trade throughout the season of 1889, and carry many orders over into the new year. They are now running their works until ten o'clock at night, in order to meet the steadily increasing demand for their specialties.

Houston's Electrical Dictionary is thus praised by the *Washington Post:* "No work of similar character has hitherto appeared that will begin to compare with this in completeness and accuracy. It is a volume of 650 pages, illustrated and compiled with the methodical carefulness and precision of a scientist who thoroughly understands what he is about. The book will be a great boon to electricians, and of valuable use to all interested in electrical progress."

The Finest on Earth.—The Cincinnati, Hamilton & Dayton Railroad is the only line running Pullman's perfected safety vestibuled trains, with chair, parlor, sleeping and dining car service, between Cincinnati, Indianapolis and Chicago, and is the only line running through reclining chair cars between Cincinnati, Keokuk and Springfield, Ill., and combination chair and sleeping car from Cincinnati to Peoria, Ill. It is the only direct line between Cincinnati, Dayton, Lima, Toledo, Detroit, the Lake Regions and Canada. The road is one of the oldest in the State of Ohio, and the only line entering Cincinnati over twenty five miles of double track, and from its past record can more than assure its patrons speed, comfort and safety. Tickets on sale everywhere, and see that they read C. H. & D., either in or out of Cincinnati, Indianapolis or Toledo. E. O. McCormick, general passenger and ticket agent.

The Fitchburg Steam Engine Company have recently shipped a 300 h. p. tandem compound engine to the Eastern Manufacturing Company, at South Brewer, Me., also tandem engine to I. E. Palmer, Middletown, Conn. They have fitted out a complete plant for the J. Middleton brick yard, Staten Island, and have also shipped engines within a few weeks to the Bradley & Hubbard Manufacturing Company, Meriden, Conn., New York *Sun* Office, New York City; the Revere Rubber Company, Chelsea, Mass.; and the Fitchburg Railroad Company, Boston, Mass. They have also started up a complete outfit for the Rutland Electric Light Company, Rutland, Vt. They are building, among other work, engines for Freeman Manufacturing Company, North Adams, Mass.; the Feather Down Company, New York City; Ticonderoga, N. Y., Pulp & Paper Company, Hollingsworth & Whitney Co., Boston, Keasby & Madison, Ambler, Pa., also three or four engines to go to Philadelphia, one to go to Illinois, and many others. Business is very good with them at present.

The Baker Common-Sense Oil Filter.—The following shipments of Common-Sense Oil Filters have been made recently by Mr. W. E. Crane, of 421 Thirteenth avenue, Minneapolis: Two to W. B. Bushnell, Tacoma, Wash.; one to Citizens' Electric Light Company, Helena, Mont.; one to Plaindealer Publishing Company, Cleveland, O.; one to Geo. M. Helme Company, Helmetta, N. J.; one to Pierce & Sowle, New Bedford, Mass.; one to Duluth Imperial Mill Company, Duluth, Minn.; one to Bloch Bros., Wheeling, W. Va.; one to St. Paul Gas Light Company, St. Paul, Minn.; one to Swan Lake Mill Company, Nicollet, Minn.; one to the Cranford Paving Company, Washington, D. C.; one to the Water & Light Company, Tacoma, Wash.; one to the Light & Power Company Ellensburgh, Wash.; one to the Townsend Electric Light Company Port Townsend, Wash.; three to Magie Bros., Milwaukee, Wis.; two to the Willamette Bridge Railway Company, Portland, Ore.; one to La Grange Mills, La Grange, Ga.; two to Hollingsworth & Whitney Company, Boston, Mass., second order; one to the Cortland Omnibus & Cab Company, Cortland, N. Y.; one to A. J. Houghton & Co., Boston, Mass.; one to Baum Bros. & Eckes, Wahpeton, Dak.; one to Brainard Milling Machine Company, Hyde Park, Mass.; one to E. P. Allis & Co., Milwaukee, Miss.; one to the

City of Goshen, Ind.; and one to C. A. Pillsbury & Co., Anoka, Minn,

McIntosh, Seymour & Co., of Auburn, N. Y., have orders on hand for engines aggregating in power over 5,000 h. p. Some of them are mentioned below: One 450 h. p double tandem compound condensing engine for a large manufacturing establishment in Auburn, N. Y.; two 350 h. p. special heavy compound engines for the Coney Island & Brooklyn Railway Company; two 250 h. p compound engines for the Natick Electric Light Company, Natick, Mass.; one 200 h. p. compound engine for the electric light company at Hyde Park, Mass.; one 200 h. p. compound engine for Bement, Miles & Co., Philadelphia, Pa.; one 200 h. p. engine for an electric light company in Burlington, Vt.; one 150 h. p. compound engine for the Auburn Electric Light Company, Auburn, N. Y.; one 150 h. p. compound engine for the Brookline Gas Light Company, Brookline, Mass.; one 150 h. p. compound engine for the Halifax Illuminating and Motor Company, Halifax, N. S.; one 150 h. p. compound engine for the Woburn Electric Light Company, Woburn, Mass.; one 125 h. p. compound engine for the Electric Lighting Company, Mobile, Ala.; one 125 h. p. compound engine for an electric light company in Mount Vernon, N. Y.; two 100 h. p. compound engines for an electric light company in Martinsburg, W. Va.; four 100 h. p. compound engines for the Interstate Gas and Water-Works Company, St. Louis, Mo., to be used by them in Mexico; one 70 h. p. compound engine for the New Jersey & Pennsylvania Construction Works; one 125 h. p. standard engine for Messrs. Claflin & Kimball, Boston, Mass.; one 50 h.p. standard engine for the United Edison Manufacturing Company, at Baltimore Md.; one 30 h. p. standard engine for the Somerville Electric Light Company, Somerville, Mass.; one 20 h. p. vertical engine for the Connecticut Industrial School for Girls, Middletown, Conn.; one 20 h. p. vertical engine for the United Edison Manufacturing Company. Their extra heavy railway engines are doing excellent work, the five that they have at the West End Railway's plant in Boston being all now in use, and they will soon have the three for the Albany power plant in operation.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED DEC. 31, 1889.

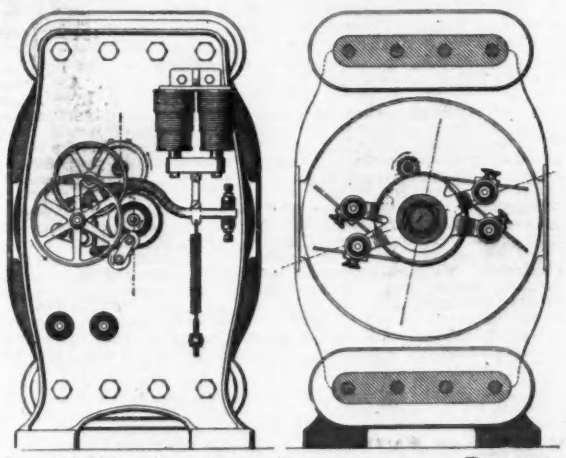
418,198. Method of Making Collars on Axles by Electricity; Herman Lemp and Elihu Thomson, of Lynn, Mass. Application filed Aug. 19, 1889. The invention consists in passing a current of electricity of large volume through a piece of metal, as a shaft or rod, while the same is threaded through the perforation in the object to be fastened to it until such bar, rod or other metal piece is softened, and then subjecting it to a suitable force, as compression, which will cause it to bulge or expand laterally to both sides of the perforated object.

418,227. Electric Exercising Machine; Edward W. Robinson, of Boston, Mass., Assignor to the Electric Exercising Company, of Nashua, N. H. Application filed July 3, 1889. In an electric exercising machine the combination of a rotating dynamo armature, a pivoted field magnet, between the arms of which the armature rotates, capable of having its arms moved transversely on either side of the armature, so as to vary the strength of the magnetic field, as may be desired.

418,248. Electro-Magnetic Motor; Nikola Tesla, of New York, N. Y., Assignor to the Tesla Electric Company, of same place. Application filed May 20, 1889. The invention consists in the method of progressively shifting the magnetic poles of one element or field of the motor by alternating currents differing in phase and passing through independent energizing circuits and short circuiting the coils of the other element. When the motor thus started reaches or passes the limit of speed synchronous with the generator, the coils previously short circuited are connected up with a source of direct current, and by a change of the circuit connections produce a simple alternation of the poles. The motor then continues to run in synchronism with the generator. See illustration.

418,249. Lightning Arrester; Elihu Thomson, of Lynn, Mass. Application filed Oct. 8, 1888. The invention consists, essentially, in rupturing the main or supply line or circuit the moment an arc forms between the plates of the lightning arrester to ground by means of an electro-magnet or other device responsive to electric currents, which is placed in the ground branch, and which actuates or brings into action a suitable circuit-breaker in the electric line or circuit to which the lightning arrester is connected as a branch.

418,258. Electric Railway Signal; Edgar C. Wiley, of Independence, Va. Application filed March 8, 1889. In a railway signaling apparatus, the continuous return conductor, the



No. 418,302.—AUTOMATIC REGULATOR FOR DYNAMO ELECTRIC MACHINES.

conductor arranged in disconnected blocks or sections and having the electrodes, with the curved elastic contact springs arranged at suitable intervals, the electrodes attached to a locomotive or train, and comprising the hinged spring pressed arms, having the segments and the flexible conducting strips extending under the segments and adapted to be in contact with at least one electrode at all times while upon one of the blocks or sections, and the signaling mechanism and electric generators in the locomotive or trains in electric circuit, with the conductor and with the electrodes having the conducting strips.

418,270. Combined Gas and Electric Light Fixture; David J. Braun, of Chicago, Ill., Assignor to the David J. Braun Manufacturing Company of same place. Application filed Sept 19, 1889. In a combined gas and electric light cock, the combination, with the "T" thereof, the screw cap upon the upper end of the T and a cock working therein and provided with a shoulder below the T, of a sectional hollow globe confined between the cap and shoulder, one of the sections being provided with one or more bosses for the attachment of the electric light fixture.

418,284. Quadruplex Telegraphy; Clarence L. Healy, of Brooklyn, N. Y. Application filed April 9, 1889. For description see last issue.

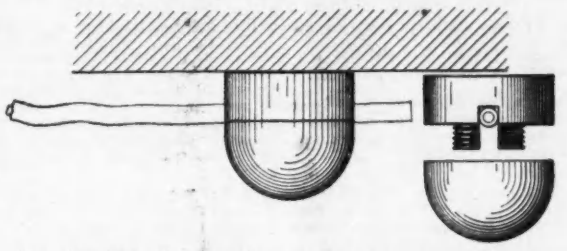
418,301. Armature for Dynamos; James J. Wood, of Brooklyn, N. Y. Application filed March 12, 1889. An annular armature core consisting of sections constructed to overlap at their junction, the end portion of one section extending outside of the other, combined with supports for the sections adjacent to their joints and engaging the exterior overlapping end portion, whereby centrifugal action is resisted by the support and the inner overlapping ends.

418,302. Automatic Regulator for Dynamo Electric Machines; James J. Wood, of Brooklyn, New York. Application filed April 27, 1889. The collecting brushes are mounted upon a suitable yoke or carrier, and connected through a suitable train of gears or by means of other mechanical connections to a friction wheel. Mounted adjacent to this friction wheel, and normally slightly out of contact therewith, are two friction rollers revolving in opposite directions by being connected to a source of power, preferably by being geared to the armature shaft, and so mounted as to be removable toward and from the frictional surface of the friction wheel. The regulating magnet, solenoid, or other electromotive device which responds to changes in its external circuit, has its moving member connected to these friction rollers in such a manner that by its movement in one direction or the other it shall move one or the other of the rollers into frictional engagement with the friction wheel, and thereby drive the latter in one direction or the other to communicate an advancing or retreating movement to the brushes. See illus.

418,303. Current Regulator for Dynamo Electric Machine; James J. Wood, of Brooklyn, N. Y. Application filed Nov. 2, 1888. In a current regulator operating by the shifting of the collecting brushes on the commutator, the combination, with the brushes, of a pair of friction rollers revolved in opposite directions from a source of power, a tractively driven moving part entering between the rollers and connected to the shifting brushes, so that its movement shall shift them, and an electromotive device responding to the changes in the current and connected to the rollers, whereby by its movement in one direction the rollers are closed together in tractive engagement with the moving part and by its movement in the opposite direction the rollers are released therefrom.

413,322. Electric Signal System for Letter Boxes; George L. B. Rounsville, of Chicago, Ill. Application filed Oct. 5, 1888. The combination with a door, of a call box and its lever, a sliding spring-controlled tube provided with a draw-bar to engage the lever, a push rod bearing against the door and adapted to enter the the tube, suitable trip levers against which the push rod normally bears, and hinged trips for tripping the levers.

418,369. Screw-Cleat for Electric Wires; George E. Huff, of Hartford, Conn. Application filed May 10, 1889. A screw-cleat for electric wires, consisting of a flat and circular disc of insulating material having a central transverse groove which is sunk in one face thereof to a uniform depth slightly less than the thick-



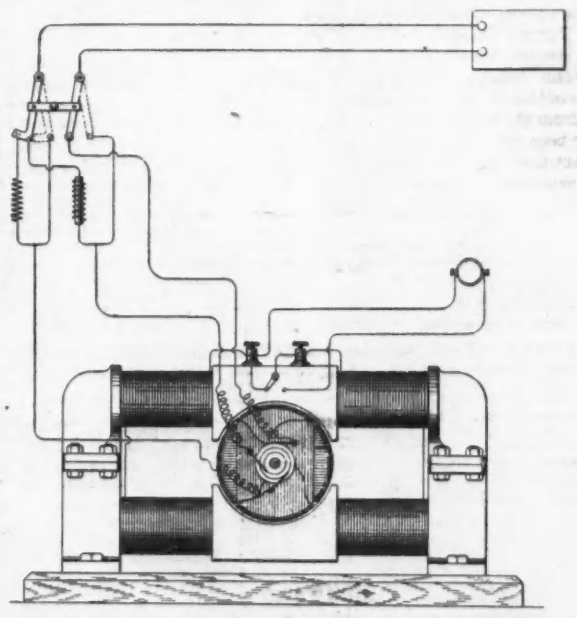
No. 418,369.—SCREW-CLEAT FOR ELECTRIC WIRES.

ness of the wire which is to be held therein, and provided with a screw which is formed integrally with the disc, projects from the middle of the face at right angles therewith, and is separated in two parts by means of a central channel continuous with the groove in combination with an internally threaded screw cap which is adapted, when turned home upon the screw, to cover the face of the disc and to exert pressure immediately upon those portions of a contained wire which lie in the terminal portions of the groove. See illustration.

418,373. Electric Railway; Hosea W. Libbey, of Boston, Mass. Application filed October 10, 1888. An elevated electric railway and support, consisting of a single row of columns, each having an arch secured to the column by braces and carrying the rail from which the car is suspended, and also an upper bar, the bracket secured to the column and carrying the rail, the rail bar being the positive and the rail the negative conductor of electricity, or vice versa.

418,402. Electric Brake Mechanism for Cars; William H. Darling, of New York, N. Y., Assignor of two-thirds to Leo. Bock, Jr., and Gardner P. Harrington, both of same place. Application filed March 23, 1889. The combination of the frame and wheels, the system of brake levers and brake shoes, the piston rods connected with the operating lever of the brake mechanism, the armatures carried by the piston rods, the electric cylinders, in the closed heads of which the piston rods have bearings, and the yokes bolted to the front ends of the cylinders, through which the piston rods extend and which limit the movement of the armatures.

418,426. Incandescent Electric Lamp Socket; Frank Thone, of Oskaloosa, Iowa. Application filed Aug. 1, 1888. In a socket for incandescent lamps, the combination of a containing



No. 418,248.—ELECTRO-MAGNETIC MOTOR.

shell or body and a switch block inserted therein and composed of wood chemically treated to render it substantially fireproof and to prevent shrinkage.

418,443. Mechanical Telegraph Instrument; Jesse H. Bunnell, of New York, N. Y. Application filed Dec. 13, 1888. Renewed Oct. 8, 1889. In a mechanical telegraph instrument, a key lever and a sounding lever, both independently pivoted in a single bridge and having overlapping extensions held in operative connection by a single spring attached to both levers.

418,444. Electric Arc Lamp; Jesse H. Bunnell, of New York, N. Y. Application filed Oct. 8, 1889. In an arc lamp the combination of an electro-magnet and armature for striking the arc, and an independent differential electro-magnet system for effecting the feed, the one magnet of the system being in series with the carbons and the arc-striking magnet, and the other magnet of the system being in shunt around the arc, but in series with the arc-striking magnet. See illustration.

418,472. Electric Meter; Charles A. Pratt, of Toledo, O. Application filed Oct. 18, 1889. In an electric meter, the combination, with an electro-magnet and its armature, of a lever integral at one end with the armature, and a spring actuated brake shoe hinged to the opposite end of the lever and adapted to frictionally bear upon the periphery of the balance wheel of the escapement mechanism.

417,474. Electric Light Carbon; Llewellyn Saunderson, of Kingstown, County of Dublin, Ireland. Application filed December 4, 1889. Patented in England September 28, 1888; in France, February 13, 1889, and in Belgium, May 20, 1889. In an arc lamp, the combination consisting of carbon electrodes (one or both hollow) connected with an electric source and usual devices for the production of the electric arc between the electrodes, a box containing vaseline or other semi-liquid hydrocarbon attached to the end of the hollow electrode farthest away from the arc, and a tightly-fitting fibrous plug inserted a short way up the electrode at the end which enters the box, and a space within the electrode void of fibrous plug or packing between the packing at one end and the arc at the other.

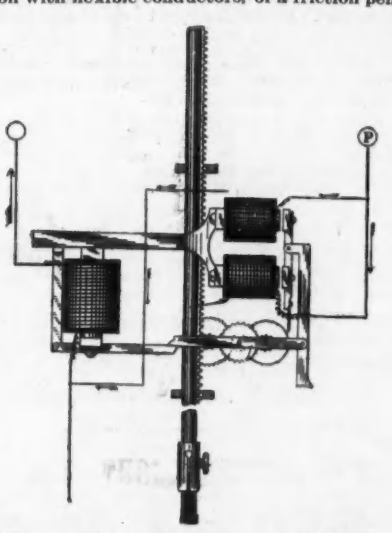
418,483. Secondary Battery; Albert Edward Woolf, of New York, N. Y., Assignor to Benno Loewy, of same place. Application filed June 20, 1889. An electrode for storage batteries, comprising, essentially, a strip of metal coated with active material, and coiled upon itself in such a manner that the active material fills all the space between contiguous layers of the metal.

418,510. Method of Finding the Position of Distant Objects; Bradley A. Fiske, of the United States Navy. Application filed June 29, 1889. The invention consists in the method, whereby observers stationed at points distant from a gun, which points command a good view of the area within the range of the gun, are enabled to discover the bearing and range of the target, and to communicate to persons in charge of the guns the bearings and range.

418,559. Electric Meter; Alphonse Jean Frager, of Paris, France. Application filed June 14, 1889. The combination of an electro-dynamometer, which indicates the electrical energy expended per second, a clock work which measures time and marks off the intervals at which the energy is counted up, and a registering apparatus which carries into effect the product of the first two quantities, and indicates on dials the total energy consumed.

418,560. Bell; Edward Frost, of Littleton, Mass., Application filed July 2, 1889. The combination of the main actuating weight and train of wheelwork with the bell hammer operated by the train of wheelwork and a spring interposed in the train at a point between the bell hammer and actuating weight, as described, whereby the bell hammer is actuated directly by the elasticity of the spring and the latter is maintained in a wound up or strained condition by the descent of the weight.

418,636. Electric Light Fixture; George C. Baillard, of New York, N. Y., Assignor to J. H. Bunnell & Co., of same place. Application filed Oct. 16, 1889. In incandescent lamp fixtures, the combination with flexible conductors, of a friction pendent block



No. 418,444.—ELECTRIC ARC LAMP.

adapted to slide thereon, provided with a recess for a lamp socket and means of attaching the same.

418,652. Generation and Distribution of Electric Currents; Francis Jarvis Patten, of New York, N. Y. Application filed Nov. 9, 1888. An alternating dynamo-electric generator having two complete, independent, external main circuits conveying, respectively, the impulses of opposite polarity of the alternating current, and suitable commutator devices for connecting the circuits to the generating circuit of the machine, whereby all impulses of one polarity are caused to traverse one external circuit, and all impulses of opposite polarity are caused to traverse the other external circuit.

418,653. System of Electrical Distribution; Francis Jarvis Patten, of New York, N. Y. Application filed Nov. 11, 1889. The method of electrical distribution which consists in sending from a dynamo-electric generator all the positive impulses of current over one lead of an external circuit, and over another lead of the external circuit all the negative impulses, causing the complete alternating wave to traverse a third conductor, and in causing the current in the latter to actuate devices requiring an alternating current, and the other current or currents to actuate devices requiring a direct current. See p. 58.

418,654. Electric Motor; Francis Jarvis Patten, of New York, N. Y. Application filed November 11, 1889. The method of operating electric motors, which consists in producing the constant magnetization of one element by sending through separate windings on the element the opposite impulses of an alternating current in opposite directions, and in giving to the other element an alternating polarity by sending through its windings an alternating current.

418,655. Distribution of Electric Currents; Francis Jarvis Patten, of New York, N. Y. Application filed Nov. 30, 1889. A system of electrical distribution, comprising an alternating current generator, a lead conveying an alternate current, other leads conveying, respectively, the positive and negative impulses of the same current, branch leads from the former connected to the middle points of storage batteries placed at distant points, and branch leads from the latter connected to the poles of the same batteries.

448,659. Dynamo-Electric Generator; William Stanley, Jr., of Great Barrington, Mass. Application filed August 31, 1889. For description see this issue, p. —.

418,662. Process of Electroplating Dental Plates; Joseph G. Ward, of Newark, N. J. Application filed November 17, 1888. The invention consists in making a positive cast of the mouth or jaw of the patient from plastic or other appropriate material in the ordinary manner, rendering the surface thereof conductive, and depositing thereon a plate in two or more strata of different metals superposed one upon the other by electro deposition.

PATENTS ISSUED JANUARY 7, 1890.

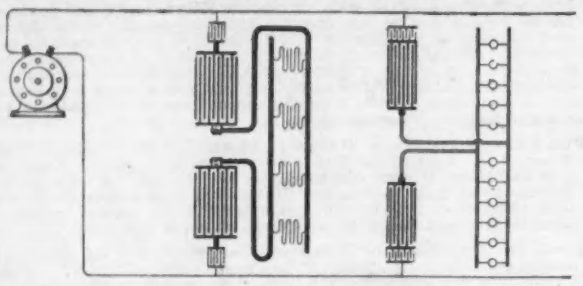
11,053. Reissue. Electric Pen Holder; Charles W. Reitler, of Denver, Col., Assignor of one-fourth to William T. Jenison, of same place. Application for reissue filed Sept. 23, 1889. The invention consists of a therapeutic pen-holder, having a tenon end and opposite electrodes or plates embedded in suitable insu-

lating material and connected together by a rivet or pin, which fits into the opening of the tenon end of the holder.

418,678. Electric Switch for Motors; Harry H. Blades, of Detroit, Mich., Assignor to the Detroit Motor Co., of same place. Application filed Nov. 30, 1888. In a shunt-wound electric motor the combination, with the field circuit, of a magnet in the circuit, a hand switch adapted to open and close the armature circuit, the switch arranged to be held in its closed position by the magnetism of the magnet, and means for automatically retracting the switch to its initial position when the magnet is de-energized by the cessation of the current through the field circuit.

418,682. Ear Phone Rest; George E. Christie, of Paterson, N. J. Application filed Aug. 13, 18 9. The invention consists in the combination of an adjustable swinging arm, pivoted to a wall bracket, means for positively limiting the movements of the arm, means for adjusting and holding it at any point, a receiver holder proper jointed to the swinging arm and swinging in the same plane therewith, and means for sustaining the receiver holder proper in any desired position.

418,685. Brush Holder for Dynamos; Peter Claus and Eugen Gengenbach, of New York, N. Y. Application filed May 11, 1889. The combination, with a support bolt or stud, of a sleeve carried thereby, a swinging brush-supporting arm, also carried



NO. 418,912.—METHOD OF TRANSFORMING AND UTILIZING ELECTRICAL ENERGY.

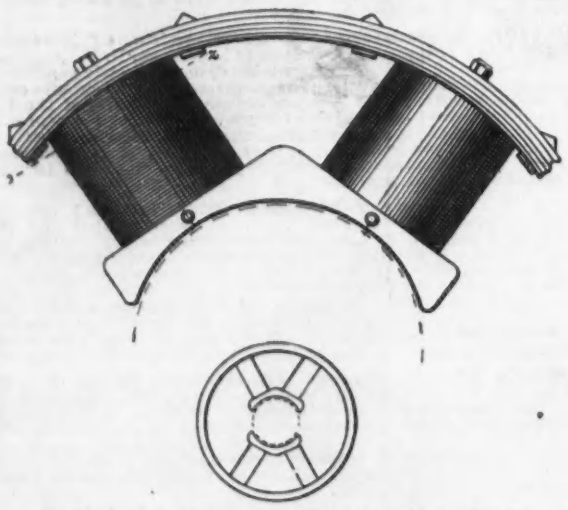
by the bolt or stud, a spring connecting the arm with the sleeve, and a flexible electric connection between the arm and the sleeve.

(1) 418,700. Secondary Battery; (2) 418,701; (3) 418,702. Cut-Out for Secondary Batteries; (4) 418,703. Method of Forming Secondary Battery Plates; Harry E. Dey, of New York, N. Y., Assignor to Phœbus H. Alexander, of Hyde Park, Mass. Applications filed (1) and (2) July 29, 1889; (3) and (4), Aug. 22, 1889. In a secondary battery the combination, with the plates, of a sheet of flexible insulating material formed with grooves or corrugations into which the edges of the plates extend, forming separate compartments or cells between each pair of plates and means for clamping the sheets and plates together to form water-tight joints. (2) A thermostatic cut-out, combined and associated with a secondary battery and adapted to be operated by the heat of the battery fluid when the temperature of the same rises to a given point. (3) The combination, with a secondary battery, of a body or receptacle containing a liquid and supported in the solution in such position that the liquid therein shall be displaced by gas evolved from the solution, and a cut out device adapted to be operated by the movement of the body, due to the displacement of liquid by the ascending gas. (See illustration). (4) The method of forming secondary battery plates, which consists in applying to the lead plates an active material in the form of a dry powder, then confining or retaining the material in place by a conducting support, then forming the material by an electric current while so confined, and then removing the support.

418,704. Bracket for Supporting Electric Conductors; John A. Duggam, of Quincy, Mass. Application filed April 19, 1889. A bracket for the suspension of electric conductors, consisting of a horizontal rod made in two parts, one sliding within the other, and a supporting rod similarly constructed.

418,718. System of Transportation; Benjamin S. Henning, of New York, N. Y. Application filed June 10, 1889. The combination, with a track terminating at each end in an upwardly inclined portion which is electrically disconnected from the central portion of an electric generator, in connection with the inclined portions only, cars upon the track adapted to be propelled along a portion thereof by gravity and momentum when starting from one end, an electric motor on one of the cars adapted to receive the current from the inclined portion of the track when moving upward on the same, and means for controlling the circuit through the motor.

418,748. Distribution of Electricity by Secondary Batteries; George B. Prescott, Jr., of Newark, N. J., Assignor to the Electrical Accumulator Company, of New York, N. Y. Application filed Nov. 8, 1889. The combination of a primary generator of electricity, a secondary battery, a working circuit therefor, a series of counter electromotive force cells, and electromagnetic switch or circuit changer for introducing and withdrawing the cells with respect to the working circuit, consisting of a bar pivoted upon a friction bearing, a magnet for moving the bar in one direction, a magnet for moving the bar in the opposite direction, a magnet in the circuit connected to opposite terminals of the working circuit responsive to variations in



NO. 418,853.—ELECTRIC MOTOR OR GENERATOR.

electromotive force and a local circuit operating the two first-named magnets under control of the second-named magnet.

(1) 418,757. (2) 418,758. Electric Arc Lamp; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed (1) Oct. 3, 1885; (2) July 2, 1886. (1) In a double carbon arc lamp, the combination, with the carbon rods, of two lifting levers, one of the levers being provided with a retaining magnet to lift one of the rods out of operation, the said retaining magnet being included in the circuit of the other carbon rod, whereby one carbon rod is held out of operation by the retaining magnet when current is flowing through the other carbon rod. (2) In an electric lamp, the combination, of two sets or pairs of carbons in multiple arc or derived circuit with one another, the members of both pairs being normally in contact, an electromagnet in the main circuit of the lamp, and a system of leverage actuated by the electromagnet and acting when the working current passes to raise the upper members of both pairs at once, so as to initially separate them, with independent electromagnets, one included in each of the said derived circuits, and armatures mounted upon the clutch levers of the upper carbons, the electromagnet in each derived circuit being placed so as to control that armature which is attached to the clutch lever of the carbons of the other derived circuit, whereby the establishment of the arc in connection with either pair of carbons is caused to maintain the separation of the remaining pair of carbons.

418,766. Support for Electric Conductors; Joseph Brodie Smith, of Manchester, N. H. Application filed Sept. 9, 1889. An insulating supporter for electric wires, consisting of a bolt or screw having a perforated head provided with ratchets upon its face, a thimble or cap having a perforated ear-piece provided with ratchets upon its face adjustable to those upon the screw head, a fastening bolt and nut, an insulator adapted to be held in the thimble and having a bell-shaped or flaring mouth, a shank forked at one extremity to sustain a wheel or roller and its other end inserted and held in the insulator, and a wheel or roller sustained by the forked shank.

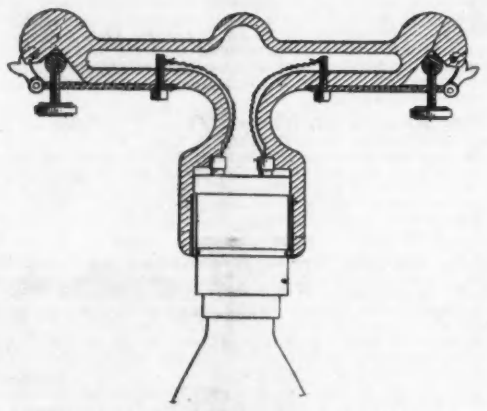
418,778. District Telegraph Alarm Box; Charles G. Armstrong, of Englewood, Assignor by direct and mesne assignments to himself and George A. Harmount, of Chicago, Ill. Application filed March 14, 1889. In a district telegraph signal box, the combination with a revoluble commutator wheel, having a series of recesses in its periphery, of the brush and the wires of a divided circuit, one of the wires being connected to the brush and the other of the wires consisting of several separate sections and suitable circuit closers, connecting the sections, which are normally disconnected from the commutator wheel, but are engaged by the same in the course of its rotation.

418,824. Lightning Arrester; Elmer A. Sperry, of Chicago, Ill., Assignor to the Electrical Supply Co., of Ansonia, Conn. Application filed April 1, 1889. In a lightning arrester, the combination of a series of movable discharge plates, a series of circuits each including one of such movable discharge plates, a series of movable stops to normally hold all but the first of such movable discharge plates out of position, a fusible conductor in each of the circuits supporting the stop for the next movable discharge plate, so that when a destructive current passes through one circuit it breaks that circuit and establishes the next.

418,837. Battery Carbon; Charles G. Armstrong, of Chicago, Ill., Assignor to George A. Harmount, of same place. Application filed Sept. 19, 1889. The invention consists of a knob or extension on the upper surface of the carbon, which is not exposed to the fumes arising in the cell. This knob or extension is surrounded by a tight band or strip of metal, to which the circuit wire is attached, the band having a close contact with the periphery of the knob, and affording a large surface contact therewith, so that the current may pass freely to the wire.

418,843. Means for the Electrical Propulsion of Vehicles; Delbert E. Johnson, of Atlanta, Ga. Application filed March 7, 1889. In an electric motor, the combination, with the shaft, of an armature rigidly mounted thereon, a field magnet surrounding the armature and supported by circular plates having sleeves revolving loosely upon the shaft, one of the sleeves being provided with a friction collar, and a friction cluten composed of two discs riding on the sleeve on opposite sides of the collar, and means for engaging the discs with, and disengaging them from, the collar.

418,850. Cable Railway Signal; John H. Pendleton, of Brooklyn, and Andrew Bryson, Jr., and Cornelius Tiers, of New York, Assignors to the Rapid Transit Cable Company, of New York, N. Y. Application filed Nov. 13, 1888. In a railway system having a stationary engine, an endless cable propelled by such engine, cars, and grip connection between the cars and cable, and insulated electric conductors parallel with the cable, a source of



NO. 418,855.—INCANDESCENT LAMP HOLDER.

electric energy, an electro-magnet at the stationary engine for signaling purposes, and circuit closing mechanism upon the cars for enabling signals to be given by the conductor to the engineer in charge of the engine, that the cable may be stopped, started, or slowed.

(1) 418,853. Electric Motor or Generator; (2) 418,855. Incandescent Lamp Holder; (3) 418,856. Carrier System; Imle E. Storey, of Boulder, Col. Application filed, (1) and (2) April 16, 1889. (3) April 25, 1889. An electric motor or generator embodying an annulus of iron, to the inner side of which are secured four field magnets arranged in pairs, the magnets of each pair connected to a common pole piece. (See illustration). (2) A three armed body having interior chambers in each arm, the chambers communicating with each other, two of the arms being fitted with binding devices for wires, and a third arm provided with a lamp socket and two contact pieces, the binding devices and contact pieces connecting, respectively, by means of conductors passing through the chambers in the arms. (3) The invention pertains to carrier systems of that class in which the driving element is a rotating tube or bar, and motion is given to the vehicle by means of friction pulleys connected therewith, which impinge on, or against, the rotating tube at an angle.

418,868. Annunciator; Julius Finck, of San Francisco, Cal. Application filed Oct. 16, 1889. In an electric annunciator, the combination of the frame having the upright arms, the magnet carried by the frame, the drop shutter normally supported on the upright arms and having arms pivoted in the frame, the arms extending below their pivotal points, and an armature pivoted in the frame and having its ends passing in front of the shutter arms below their pivotal points, whereby when the armature is attracted its ends will come in contact with the arms and throw the shutter down.

418,871. Electrical Indicating Apparatus; George A. Holt, of Oakland, Cal.; Mary E. Holt, administratrix of said George A. Holt, deceased. Application field April 15, 1889. In an electrical indicating apparatus, the combination of separate indicators, an electric circuit including them, and the means by which the circuit is closed and opened, whereby the movement of one indicator is transmitted to another, consisting of a sliding contact bolt adapted to make and break the circuit, a moving finger of the first-named indicator for operating the bolt, and a spring-controlled catch for holding the bolt in position to close the circuit.

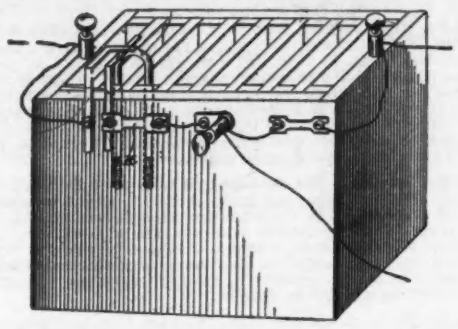
418,893. Electrically Propelled Vehicle; Rudolph M. Hunter, of Philadelphia, Pa. Application filed Sept. 16, 1889. In an electrically propelled vehicle, the combination of the axles, a frame journaled upon one axle and loosely or flexibly connected with the other axle, a motor supported upon the frame, and connecting gearing between the motor and axle on which the frame is journaled, consisting of a worm wheel secured on the axle and a worm rotated by the motor shaft.

418,910. Electrical Signal Operating Device; Charles A. Cox and Joseph Franklin Cox, of Louisville, Ky. Application filed May 11, 1889. The combination, in a railroad signaling system, of a track or way, a locomotive or car moving thereon, a plurality of partial electric circuits having their terminals included in the track or way, a battery external to the locomotive or car switch, connections for including the battery in any of the partial circuits, an electrically operated device having a plurality of visual signals and independently operated actuating means therefor, and lower contacts to complete the partial circuit through the signal operating devices corresponding therewith.

(1) 418,911. Electric Heating Apparatus for Electric Railway Systems; (2) 418,912. Method of Transforming and Utilizing Electrical Energy; Mark W. Dewey, of Syracuse, N. Y. Applications filed (1) Aug. 19, 1889. (2) Sept. 30, 1889. (1) The combination, with an electrically-propelled vehicle, working conductors supplied with currents along the path of the vehicle, a conductor on the vehicle in movable contact with the working conductors, and the electric motor to propel the vehicle, of a dynamo generator on the vehicle, operated by the same source of energy and constructed to generate currents of great volume, a circuit of low resistance connected to the dynamo, one or more electric heating devices included in the latter circuit, and means to control the movement of the dynamo independent of the movement of the motor. (2) The invention consists in charging a member of a condenser with electricity and simultaneously inducing a transformed charge of electricity on another member of a condenser, and then discharging the transformed charge through suitable electric translating or consumption devices. See illustration.

418,987. Electric Arc Lamps; Edwin C. Russell, of Skowhegan, Me. Application filed July 24, 1889. In an arc lamp, the combination of an electromagnet, an armature, a rotatable disc of carbon, a ratchet wheel secured to the disc at its axis, an arm, pivoted to the lamp frame work, which is attached to the armature and provided with double pawls, which have alternate engagements with the ratchet wheel when the armature is attracted and released by the magnet.

419,013. Electric Belt; Charles Henry Grimley, of New York, N. Y. Application filed March 23, 1889. An electric belt comprising a strap, a back piece on the rear side, a face piece or lining on the front side and stitched at its ends and upper edge to the back piece, the lower edge remaining unstitched; the gal



NO. 418,702.—CUT-OUT FOR SECONDARY BATTERIES.

vanic elements of metal arranged in series overlapping each other in pairs and separately riveted to the belt, absorbent cloths inserted between the pairs and the cloths and elements being attached to the strap and the back piece by eyelets, the conducting links attached to the terminal elements by the eyelets, and the electrodes arranged on the face of the lining and attached to the ends of the conducting links by eyelets, the lining forming a covering for the galvanic elements.

419,032. Method of Welding by Electricity; Charles L. Coffin, of Detroit, Mich. Application filed June 25, 1889. The process of welding which consists in electrically welding metals together in a non-oxidizing medium.

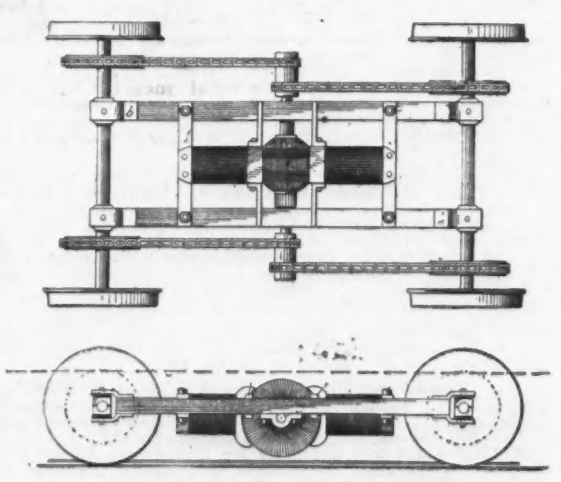
419,033. Method of Electric Welding; Ch. L. Coffin. Detroit, Mich. Application filed Sept. 11, 1889. The invention consists in subjecting the joint to be welded to the influence of a magnet across the path of the current.

419,059. Electric Motor; Harry B. Niles, of Union Springs, N. Y. Application filed April 4, 1889. The magnet spools are mounted upon two iron stringers in such a manner that the stringers form a part of the magnetic circuit. The stringers also act as guide ways upon which the magnets may slide toward and away from the armature for purposes of making repairs, etc., to the latter. See illustration.

419,094. Apparatus for Propelling Vehicles by Electricity; Frank Wynne, of Westminster, England. Application filed Dec. 1, 1887. Patented in England, Jan. 17, 1887. In an apparatus for propelling vehicles by electricity, the combination of an insulated main conductor of electricity, a series of insulated contacts distributed along and having parts exposed in the road or track over which vehicles are to be electrically propelled, and adapted to be temporarily connected in consecutive order with the main conductor on the passage of the car-motor, cores or masses of magnetic material, solenoid or coils for polarizing the cores or masses, each of the solenoids or cores being in electrical connection at one end with the road contact and at its other end adapted to be temporarily placed in electrical connection with the main conductor by a contact maker located in the rear of the road contact, the contact maker being adapted to be operated by the cores or masses of magnetic material when the same are polarized, and to electrically connect the road contacts in consecutive order with the main conductor, a car motor, and a car contact in electrical connection with the car motor and adapted to make contact with two or more of the road contacts.

419,111. Insulated Nippers; Firmin M. Casey, of Mt. Vernon, N. Y. Application filed Oct. 24, 1889. In insulated nippers, cutting instruments, and similar articles, the handles made separate from the body and jaws, and connected therewith by screw connections.

419,166. Electro-Magnetic Transmitter; John Thomas Williams, of Mount Vernon, Assignor to the International Portelectric Company, of New York, N. Y. Application filed



NO. 419,059.—ELECTRIC MOTOR.

March 9, 1889. The combination, with the helices, the track, the conductors extending through the helices, the electric generator, and the connections between the helices, conductors, and electric generator, of a carriage and pairs of spring arms, each pair secured at one end to the carriage and pressing toward each other at their free ends, and contact wheels carried by the free ends of the springs, rotating in an approximately horizontal plane, and by the spring arms pressed toward each other to grip the opposite side of the conductors.

PATENTS EXPIRED DEC. 31, 1889.

134,364. Galvanic Batteries; Augustus G. Davis, of Baltimore, Md. A positive element having a ring and projections with beveled edges, and a negative element, composed of concentric corrugated or stellar-shaped strips.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.